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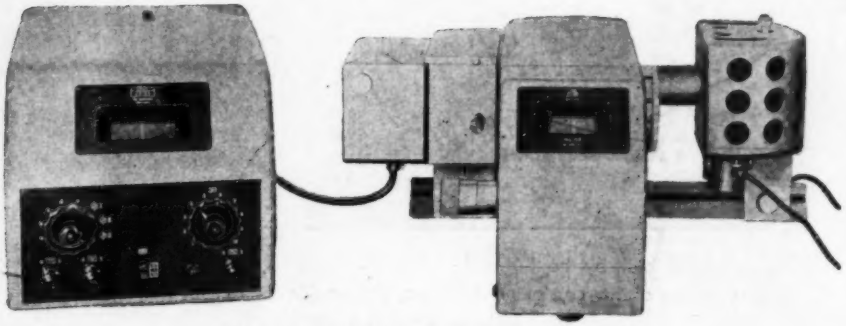

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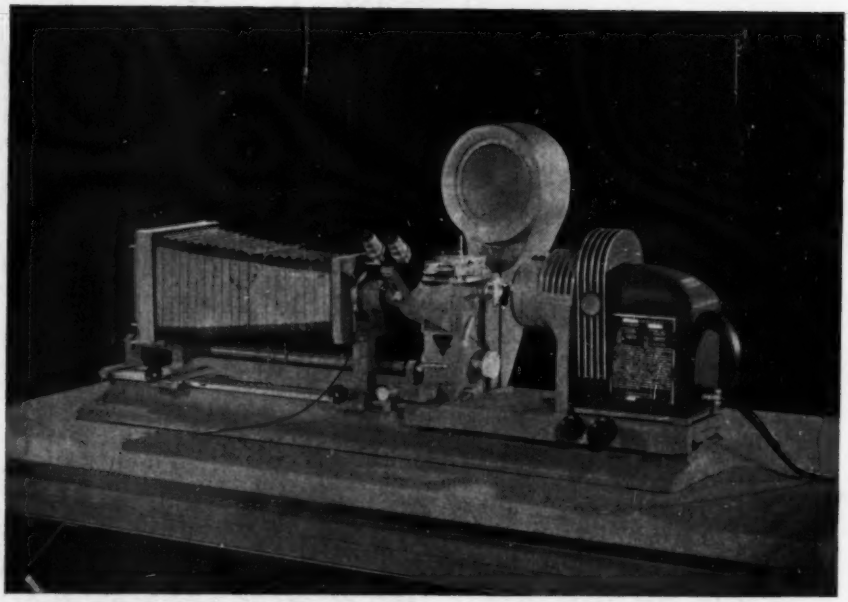

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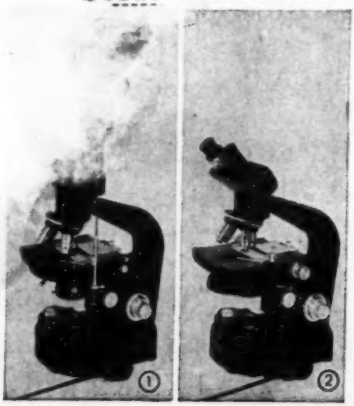

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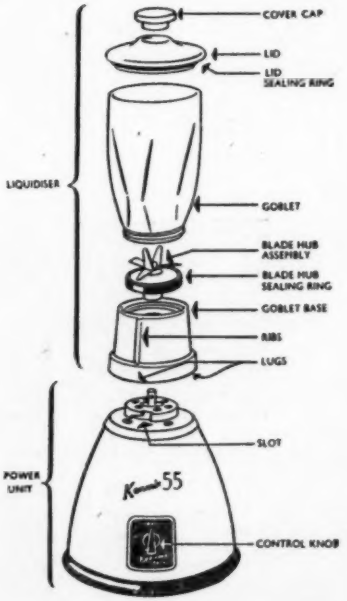

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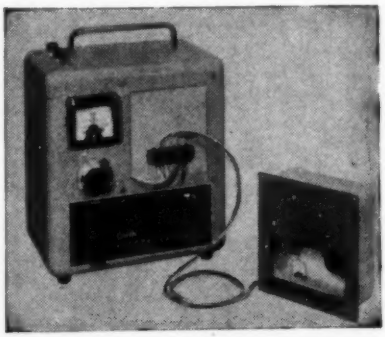

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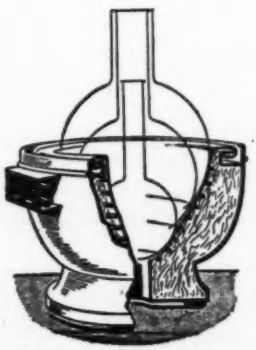

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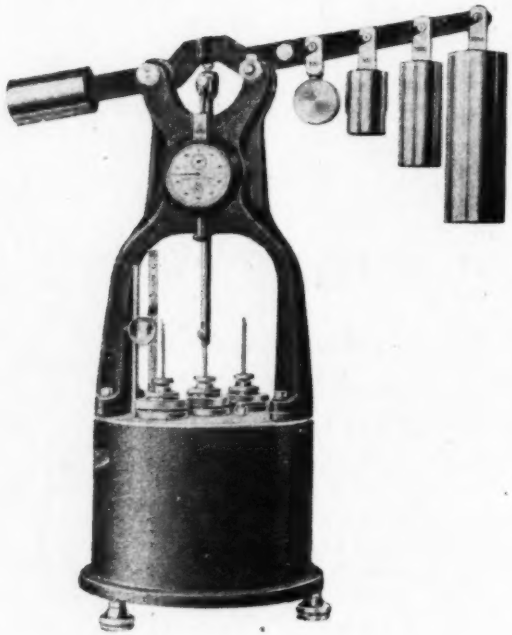

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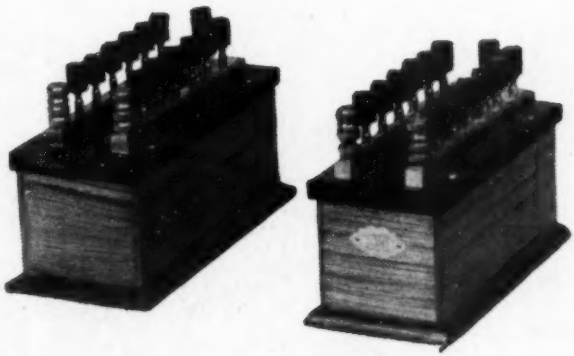

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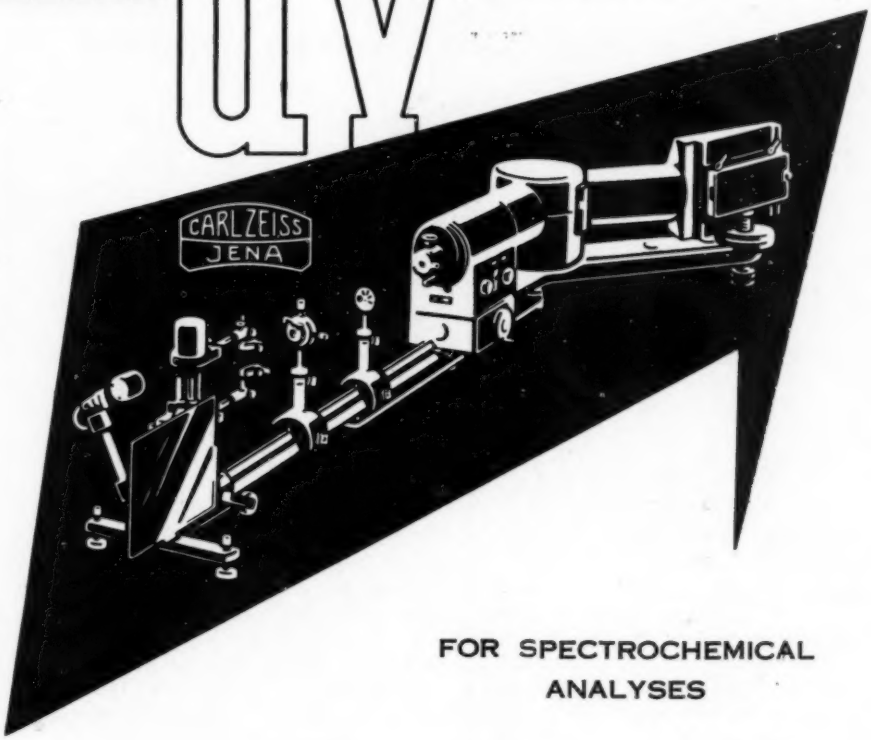

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PERCUSSION FIGURES IN CRYSTALS

SIR C. V. RAMAN

THE impact of elastic solids was the subject of investigation by the author many years ago. The earliest of his publications on the subject which appeared in the *Physical Review* for December 1918 recorded the discovery that the coefficient of restitution in the impact of elastic solid spheres tends to unity as the velocity of impact diminishes and becomes small, a result which could have been anticipated from theoretical considerations. His second paper which appeared in the *Physical Review* for April 1919 considered the problem of the impact of spheres on elastic plates of finite thickness but of extended area. It was shown theoretically and confirmed experimentally that the kinetic energy of the impinging sphere is transferred to the elastic plate as energy of wave motion to an extent determined by the thickness of the plate and that as a consequence, the coefficient of restitution diminishes progressively from unity for thick plates to small values for thin ones.

In the course of the studies referred to above, the remarkable effects arising from the impact of a polished sphere of steel on the surface of a thick slab of glass came under the notice of the author. They were described and illustrated in a note published in *Nature* of the 9th October 1919. Some further studies of the same effect were later reported in the *Journal of the Optical Society of America* for April 1926. It had long been the intention of the author to return to the subject and investigate the effect of impact of spheres on crystal slabs. Only recently, however, did this intention materialize. Studies have been made of the results of the impact of polished steel spheres of appropriately chosen size on the optically polished surfaces of quartz, calcite, barytes and felspar. The results of the study show clearly that though the size of the sphere and the velocity of the impact are important factors, the general nature of the effects observed is a characteristic property of the crystal itself and is related both to the structure of the crystal and to the orientation of the face on which the impact occurs. The importance of the subject is thereby made evident and a wide field of research is opened up. It is proposed to give here a brief account illustrated by selected photographs of the results of the research. The interested reader will find a more detailed account and many more illustrations in the paper published by the author in the *Proceedings of the Indian Academy of Sciences* for December 1958.

2. PERCUSSION FIGURES IN GLASS

It is useful to commence with a brief account of the effects observed when a polished steel sphere is dropped on the smooth surface of a thick slab of glass from an appropriate height. The most striking feature of the percussion figures observed in the glass is a fracture which is symmetrical in shape and extends inwards from a ring-shaped crack on the surface to a sharply defined limit in the interior. The fracture exhibits interference colours both in transmission and by reflection, these being complementary to each other. A remarkable feature is that the area over which the sphere and the glass come into contact during the impact exhibits no visible damage, and indeed only with difficulty can one perceive by passing the finger over the surface of the glass that the impact has had any effect at all. The ring-crack from which the internal fracture spreads inwards is however readily visible at the surface, and a critical examination by reflected light also reveals a slight elevation of the surface round the crack, as is naturally to be expected from the presence within the glass of fracture surfaces which are separated from each other. This effect is however best exhibited by placing a test plate of glass over the percussion figure and

observing the interferences between the lower surface of the test plate and the upper surface of the glass slab by reflected light. Monochromatic light, *e.g.*, that of a sodium lamp should be used for the observations. The phenomenon of which a photograph is reproduced as Fig. 1 (*a*) is then observed.

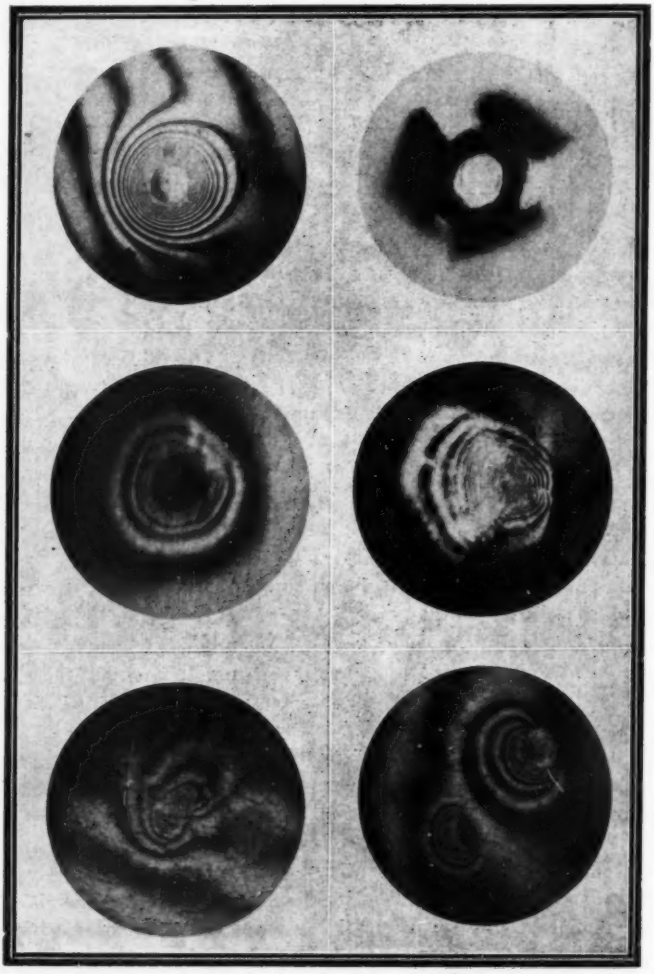


FIG. 1. Percussion Figures.

At the centre of the figure is seen the undamaged area of the surface bounded by the circular ring crack. There is then a sudden elevation of the surface which is symmetrical around the area and slopes down gradually to the original level on all sides, as is shown by the configuration of the closely spaced circular interference rings.

3. Percussion Figures in Quartz

The nature of the results observed with quartz is found to depend notably on the orientation of the surface on which the impact occurs. The most interesting results are those noticed when this surface is perpendicular to the optic axis of quartz

Figs. 1 (*b*) and 1 (*c*) reproduce photographs of the percussion figure observed in this case, Fig. 1 (*b*) representing what is observed by transmitted light and Fig. 1 (*c*) being the interference rings observed when a test plate is laid on the slab of quartz over the percussion figure. Fig. 1 (*b*) exhibits the very striking fact that the fracture surface inside the quartz exhibits only trigonal symmetry and *not* hexagonal symmetry. This feature is further evident from the nature of the elevation of the surface as revealed by Fig. 1 (*c*). There are, of course, many other features noticeable in the photographs reproduced, but it is not possible to refer to them here in detail. They will be found fully set out and illustrated in the detailed paper referred to above.

4. Percussion Figures in Calcite

Figure 1 (*d*) illustrates the effect of dropping a small steel sphere on the rhombohedral face of a crystal of calcite which had been smoothed and polished to optical perfection. The photograph was taken with a test flat laid on the surface and allowed to settle down. Much the same features are also exhibited by the percussion figure itself without a test plate. An examination of the percussion figure reveals that the characteristic cleavages of calcite play an important role in determining the results of the impact. Indeed, it is observed that on either side of the area of contact between the impinging sphere and the crystal, two cleavages making an acute angle with each other develop and extend outwards from the edges of that area. These cleavages are clearly visible on the face of the crystal and they sharply limit the area within which the fracture develops and spreads inwards. Another interesting feature is the appearance of a whole series of parallel lines outside the region of contact and only on one side of it. These lines are equally inclined to the two sets of cleavages and may be explained as due to glides occurring within the crystal along the direction of a rhombohedral edge.

5. Percussion Figures in Other Crystals

Quartz and calcite are specially suited for studies of the kind described, since it is possible to obtain fairly large specimens which are clear enough to enable the results of the impact within the crystal to be satisfactorily observed. In other cases, it is not so easy to find material of this quality which could be used for such studies. There is usually no difficulty, however, in obtaining single crystals of the desired size on which surfaces of the desired orientation can be cut, ground and polished to optical perfection. The results of the impact on the *external* surface can then be readily studied by placing a test plate on it and observing the configuration of the interference patterns seen in monochromatic light. These patterns are found to be highly characteristic of the material studied as well as of the chosen orientation of the surface. Fig. 1 (*e*) in the plate shows the pattern observed with barytes and Fig. 1 (*f*) with felspar.

THE INDIAN ACADEMY OF SCIENCES

AT the invitation of the Maharaja Sayajirao University, the Twenty-Fourth Annual Meeting of the Academy was held in Baroda on the 27th, 28th and 29th of December 1958.

The function which was held in the Central Hall of the Baroda College before a large and distinguished gathering was inaugurated at 17·30 hrs. on the 27th by His Highness Maharaja Fatehsinh Gaekwad, Chancellor of the University. In a felicitous speech His Highness appealed to the scientists "to fashion their work in such a way that its results would be useful for bettering the life of the common man." The ultimate aim of all sciences, he said, is and ought to be the well-being and all-round progress of humanity. Earlier Dr. J. M. Mehta, Vice-Chancellor of the University in his welcome address referred to the relation between

Science and the State and the role of the Universities in this connection.

Sir C. V. Raman, President of the Academy, then introduced the Fellows present and delivered his Presidential Address on "The Infra-red Spectrum". In this address he outlined a new approach to the explanation of the infra-red absorption spectra exhibited by molecules and crystals, basing it on the fundamental notions of the quantum theory. A detailed account of the theory will appear in a later issue of *Current Science*.

On the second day, the morning session opened with a symposium on "Elementary Particle Physics" under the chairmanship of Dr. S. Bhagavantam. The symposium was started by Dr. Alladi Ramakrishnan with his introductory address on "Propagators and virtual states". The other papers presented at the symposium were "Three fundamental representations of quantum field theory" by G. Ramachandran; "Quantum mechanical aspects of angular momentum" by V. Devanathan; "Angular correlations" by R. Vasudevan; "Weak interactions" by N. R. Ranganathan; "Chew's theory of meson interactions" by K. Venkatesan; "Nucleon-nucleon interactions" by Dr. S. K. Srinivasan.

In the afternoon session at the scientific meeting in Section A, a number of papers were presented and discussed. Sir C. V. Raman spoke on "Percussion figures in crystals". A report of his address appears elsewhere in this issue. Dr. K. S. Viswanathan presented the results of a mathematical investigation on "The relativistic theory of chemical binding". Applying Breit's equation for a hydrogen molecule (or for a system having cylindrical charge symmetry) the total angular momentum component along the molecular axis comes out as a constant of motion and as such every eigenstate of energy of the system can be specified by only one parameter, namely, the eigenvalue of the total angular momentum along that axis. Prof. A. Jayaraman delivered an address on "The iridescent felspars" in which he presented the results of optical and X-ray investigations, including especially the effects of heat treatment on the structure of these felspars. Dr. D. Krishnamurti presented the results of an investigation by him on the Raman spectra of $NiSO_4 6H_2O$ (tetragonal and monoclinic forms), $NiSO_4 7H_2O$ (orthorhombic) and $MnSO_4\ 4H_2O$ (monoclinic). The full report on this work has appeared in the December 1958 issue of the *Proceedings of the Academy*.

The other papers presented at the meeting were: "Condensation of 4-Nitro-O-phenylene diamine with aromatic aldehydes" by Dr. N. V. Subba Rao and C. V. Ratnam; "Solar and climatic data for building design in India" by Dr. T. N. Seshadri; "The effect of ionization on the grains of a nuclear emulsion" by Dr. Yog Prakash; "Specific heats of metals at liquid helium temperature" by Dr. K. G. Ramanathan.

In the evening there was a public lecture by Dr. N. Kesava Panikkar on "Indian Fisheries".

On the third day, there was the scientific meeting in Section B, at which Prof. T. S. Sadasivan took the Chair. He delivered an address on "The problem of blast disease of rice", a summary of which appears elsewhere in this issue. This was followed by an interesting lecture on "Cytogeography of some Indian plants" by Dr. E. K. Janaki Ammal.

Dr. R. Subrahmanyan presented the results of his work on "Phytoplankton of the west coast of India" which extended over a period of six years. He dealt with all aspects of phytoplankton production and the factors affecting the same, as well as with its effect on the economy of the waters of the West Coast of India. Prof. R. V. Seshaiya spoke on "Some aspects of estuarine hydrology and biology".

In the evening Dr. S. Bhagavantam, Director of the Indian Institute of Science, Bangalore, gave an illustrated lecture on "Sounds we cannot hear".

At the special request from the public of Baroda, Sir C. V. Raman stayed over for the 30th December and gave an evening lecture on "Diamonds".

At the business meeting of the Academy held on 27-12-1958, the following were elected to the Academy:

Honorary Fellows.—Prof. J. Bjerknes, U.S.A.; Prof. Jaroslav Heyrovsky, Czechoslovakia; and Academician A. F. Joffe, U.S.S.R.

Fellows.—Messrs. K. Chandrasekharan, D. Krishnamurti, S. Pancharatnam, V. Prabhakar Rao, K. Subramanyam, M. S. Swaminathan and B. V. Thosar.

OBITUARY

SIR MIRZA M. ISMAIL

THE death of SIR MIRZA M. ISMAIL on the 5th of January 1959 at his residence "Windsor Lodge" in Bangalore came as a rude shock to his many friends and admirers in the country. Sir Mirza was seventy-five years of age and was apparently in good health. The end came very suddenly through an attack of coronary thrombosis.

Sir Mirza's remarkable career had its origins in his association with Maharajah Krishnarajendra Wadiyar who was the Ruler of the State of Mysore for many years. Sir Mirza held various official positions from the year 1908 onwards which brought him into close personal contact with the Maharajah and enabled the latter to appreciate his great abilities. This led to his selection for the high office of Dewan in the year 1926. He held this position for over fifteen years, during which period the Mysore State achieved notable progress in many directions. Sir Mirza enjoyed the confidence of the Maharajah to the fullest extent and was therefore in a position to exercise the initiative and reforming zeal which were a marked feature of his activities in office. These activities covered many fields and were inspired by a deep interest in the welfare of the people. Sir Mirza's accessibility and personal charm, coupled with his breadth of understanding and his keen sense of human and cultural values made him a great and highly successful administrator.

We would like in the pages of *Current Science* to pay a special tribute to Sir Mirza's appreciation of scholarly achievements and to his understanding of the value of scientific research for the advancement of the country. These found eloquent expression in the admirable speech made by him at the Inaugural Meeting of the Indian Academy of Sciences held at Bangalore on the 31st of July 1934. In that address he paid a tribute to the recent developments in the field of scientific research in India and referred to the successes achieved by it as "having been nothing short of spectacular" and as "brilliant discoveries which have done much to bring India to the forefront among the nations in the field of scientific advance". In that speech also, he welcomed the choice of Bangalore as the home of the Indian Academy of Sciences and stated that "no more favourable ground than Bangalore could be found for the germination of the idea of an Indian Academy of Sciences and for the subsequent growth of the organism into a flourishing national institution with the necessary international affiliations".

Sir Mirza's address at the Inauguration of the Academy was followed up soon afterwards by the action taken by the Maharajah on his recommendation in making a gift in perpetuity to the Indian Academy of Sciences of the magnificant site of eleven acres of land on which the Academy itself, as well as the laboratories of the Raman Research Institute and the office of *Current Science* are at present located. The Government of Mysore also sanctioned a substantial annual grant in aid of the publication of the *Proceedings* of the Academy. These *Proceedings* have continued to appear since the inauguration of the Academy in an unbroken sequence month after month on the due dates for the last twenty-four years. Men of science in India have therefore good reason to be grateful to Sir Mirza Ismail for his farsighted wisdom.

For many years, in fair weather as well as in foul, Sir Mirza Ismail remained the truest of friends to the writer of this notice, ever ready to give him support and advice when needed. He leaves behind him a memory which will be treasured and cherished by all who have known him.

C. V. RAMAN.

REFINING OF COTTON-SEED OIL

KAILASH CHANDER AND T. R. SESHADRI
Department of Chemistry, University of Delhi, Delhi

COTTON is a major world crop and is the basis of a very large industry. Cotton-seed is produced as an important by-product. It is a useful oilseed capable of yielding a high percentage of good quality oil, but there has been serious difficulty in utilising it. This is due to the presence in the seed and in the raw oil of a toxic and colouring principle called gossypol and some related pigments. Consequently, it has not been fully used. Employing control methods at various stages and modern technological advances, the industry in U.S.A. has had considerable success. Still the success has been only partial and the cotton-seed oil has posed a problem which has defied complete solution for a considerable number of years.

Normally, the presence of colouring matters in oils is not objectionable because they are non-toxic and are sometimes useful, *e.g.*, carotenoids. However, gossypol present in cotton-seed oil is not only toxic but can also get easily oxidised and produce a dark colour. Since it is a phenolic substance, it may be normally expected that alkali washing would remove it from the oil. This seems to happen to a limited extent when the quality of the seed and the efficiency of the processes are high. But in general various changes take place during storage of the seed and oil and during the alkali refining process; as a consequence, the colour gets fixed, in the sense that it cannot be removed by alkali treatment. Such oils deteriorate on storage and produce further colour even after processing. Treatment with bleaching earths does not remove the defect.

The position is particularly difficult when we consider cotton-seed oil as is usually available in India. Most of the crushing units are relatively small and do not employ good techniques of storing and crushing. They crush the seed even without delinting and dehulling (the hulls have recently been shown to contain leucodelphinidin[1]). Consequently, the quality of the oil is very poor. It has become customary for the oil millers to give an alkali wash with a view to improve the colour and remove the free fatty acid. When this does not effectively reduce the colour, the oil is sometimes exposed to the sun for bleaching. It has been found during our investigations that these alkali washed or semi-refined oils, as they are called, are more difficult to refine than the crude oils. These oils have been found to show marked fluorescence. For these reasons in spite of its abundant availability and good economic prospects, cotton-seed oil has not been popular with the vanaspati industry. Of the annual production of 1·7 million tons of seed barely 6% is crushed for purposes of oil, the rest being used mainly as cattle feed. The solution of the problem of cotton-seed oil purification lies in the complete removal of gossypol by a mild reagent which does not cause any complication. The use of caustic alkali brings about not only loss of oil, but also certain changes which are undesirable and which lead to colour fixation in several cases. The precise reason for this phenomenon is not quite clear. For the purpose of complete removal of gossypol, use has been made of its capacity to form oil insoluble Schiff bases with amines. Various derivatives of aniline were tested and the most satisfactory results have been obtained by the use of *p*-amino-benzoic-acid.[2] But this method cannot be used on an industrial scale since the reagent used to remove gossypol is comparatively costly.

For nearly 20 years much interest has been shown on the chemistry of gossypol which is a beautiful golden yellow substance with unique chemical properties and structure. Considerable difficulty was experienced even in the isolation of pure gossypol in good yield. In recent work on flavonoids, a group of compounds which occur widely in the plant kingdom, aqueous borate solution has been found to be very useful for purposes of extraction and separation of the components. This is dependent on the presence of orthohydroxy carbonyl groups and catechol units in them. Since gossypol has in its molecule similar groups, the above method appeared to be applicable. It readily forms a water-soluble borate complex which is stable in alkaline solution and on acidification yields gossypol in good yield.[3] An extension of the use of this discovery has provided a convenient method of purifying cotton-seed oil and cotton-seed cake and yields products free from this toxic and colouring principle. At the same time the gossypol present can be recovered fully as a by-product.

THE PRESENT METHOD

In our method, crude cotton-seed oil is agitated with an aqueous solution of sodium borate or borax with or without addition of extra alkali

to dissolve out gossypol and related pigments; some other impurities such as gums and phosphatides also separate out as amorphous precipitate. After these are removed alkali refining of the oil is done in order to remove free fatty acids and other impurities. Alternatively, alkali-refining could be done without prior separation of pigment-borate complexes. This method can be operated both as a batch process as well as continuous process. We have found that the procedure is very effective and removes the pigments completely as shown by ultraviolet absorption measurements. There was no colour reversion by keeping the treated oil samples at 39-40° for one month. The new method is also simple and highly economical in chemicals, labour and heating. Further, the soap stock obtained in our process is of much better quality and can easily be processed to yield good quality soap, while the soap stock that is obtained by the current practice is very dark in colour and fetches hardly any price. This further reduces the cost of refining.

Search for earlier patent literature has revealed that the use of boron derivatives was considered in the past. McNicoll[4] suggested the use of borax or magnesium borate in sufficient quantities along with boric acid or glycerine for the precipitation of gossypol from cotton-seed oil. He insisted on acidic conditions. Johnson[5] proposed the use of esters prepared from boric acid anhydride and glycerol for the same purpose. These seem to have been empirical suggestions with no clear idea of the structure of gossypol and the reactions involved. They have not been obviously useful and have not been mentioned in treatises on cotton-seed oil (Bailey, *Cotton-seed and Cotton-seed Products*, Interscience Publishers, Inc., New York, 1948). The use of glycerine and boric acid actually stops the reaction of borax with gossypol (boric acid does not dissolve or precipitate gossypol and glycerine itself forms a water-soluble complex with borate solution) and the method becomes unworkable. The glycerol esters of boric acid anhydride are of no use in the removal of gossypol.

The new method is rational and efficient and has worked successfully in large-scale trials. One of its important features is the ready formation under mild alkaline conditions of gossypol-borate complex in preference to reaction with free fatty acids present in the oil. Consequently, the whole of the gossypol gets removed and very little of the free fatty acids is lost.

1. Kailash Chander and Seshadri, T. R., *J. Sci. and Industr. Res.*, 1957, **16 A**, 319.
2. Dechary, J. M., Kupperman, R. P., Thurber, F. H. and O'Connor, R. T., *J. Amer. Oil Chem. Soc.*, 1954, **31**, 420.
3. Kailash Chander and Seshadri, T. R., *J. Sci. and Industr. Res.*, 1958, **17 B**, 279.
4. *U.S.P.*, May 1928, **1**, 671, 834.
5. *B.P.*, Oct. 1932, 398, 405.

INDIAN AGRICULTURAL RESEARCH INSTITUTE—AGRICULTURAL UNIVERSITY

THE Indian Agricultural Research Institute has been conferred the status of a University which will confer on her students the Degrees of M.Sc. and Ph.D. in all the important subjects of Agricultural Science.

The decision of the Government of India to establish a Post-Graduate School at the Institute solely devoted to Post-Graduate teaching in the Agricultural Sciences is a noteworthy event and will mark a new era in the annals of the agricultural research and education.

The Institute is locally and popularly known as the Pusa Institute, after the name of a small village called Pusa in Bihar where it was first established in 1905, with a munificent donation of $ 30,000 by Mr. Henry Phipps, an American philanthropist. Since its foundation, the Institute has always symbolised the growth and development of agricultural research and education in India.

The present decision to provide at this Institute a full-fledged Post-Graduate School is but a natural step in crystallising the shape and in fulfilling the objects which the planners of the Institute had in view. The recommendations of the Indo-American Team on Agricultural Research and Education were instrumental in giving shape to the idealism of its founders. The Post-Graduate School which will mainly be responsible for carrying out the teaching programme has come into existence with the generous aid of the Rockefeller Foundation of the U.S.A. The aim is to train leaders who will dedicate themselves to the improvement of agricultural technology in India and who will have the competence, in the scientific disciplines concerned, to lead the programmes effectively.

Provision has been made, for the present, for admitting each year up to one hundred students for the M.Sc. Degree, and fifty students for the Ph.D. Degree.

FRACTIONATED X-RAY DOSE AND CHROMOSOME ABERRATIONS IN BARLEY

H. K. JAIN AND P. K. MUJUMDER

Indian Agricultural Research Institute, New Delhi

THE early experiments of Sax[1,2] which showed that the yield of chromosome aberrations was greater at higher intensities of irradiation and which were interpreted as indicating that restitution and reunion of broken ends take place within a very short time of their occurrence, pointed the need for studying the effect of dose fractionation on chromosome breakage. Experiments of this nature by a number of investigators with *Tradescantia* as the experimental material have given conflicting results, leading to two opposite interpretations—one supporting the theory of immediate restitution and reunion, the other consistent with the conclusion that the breaks may remain open for 12 hours or more.

In the present study, barley root tips were irradiated with an X-ray dose of 2,400 *r* given continuously or divided into two equal fractions separated by 2, 4, 6 and 8 hours. The continuous dose or the first fraction of it was given to the root tips of seeds which had been kept for germination for 15 hours. Observations on the division cycle in the root tips had been made earlier and it had been determined that the cells, in the 15 hours sample, exist in resting stage and do not emerge from this condition, *i.e.*, enter prophase until about 9 hours later. In this way it was ensured that both the continuous dose and its variously separated fractions were given to cells in the same stage. In order to find out whether the sensitivity of the chromosomes and other factors determining breakage yield vary during the course of the resting stage, the continuous dose was also given to 17, 19, 21 and 23 hours old samples, thus covering the entire length of the resting stage over which the two fractions were spread. All the fixations were made 13 hours after the beginning of the first exposure, with the exception of the above four samples which were fixed after shorter periods as shown in Table I. The root-tips irradiated with the continuous or the variously fractionated dosages were treated with a 0·2% aqueous solution of colchicine for a period of 5 hours immediately before fixation in order to arrest the cells at metaphase for scoring the aberrations. The irradiation was done at an intensity of 2,400 *r* per minute at a distance of 15 cm.; the operating voltage being 50 kV. The germinating seeds before and after the treatment were kept at a constant temperature of 24 ± 1° C. in a Cenco incubator. The Feulgen squash method coupled with counterstaining in aceto-carmine was used for making the preparations.

The aberrations recorded as chromosome reunions were the dicentric chromosomes and the centric rings; those recorded as breaks,

TABLE I

Showing the frequencies of reunions and breaks due to (i) *a 2,400* r *continuous dose given at different periods of the resting stage,* (ii) *a single half-dose of 1,200* r, *and* (iii) *the 2,400* r *dose separated into two equal fractions*

Interval between the fractions (hrs.)	Interval between fixation and First Exposure (hrs.)	Interval between fixation and Final exposure (hrs.)	Chromosome reunions per 100 cells		Chromosome breaks per 100 cells	
0	13	13	21·43±2·258	C.D. 6·42	98·57±4·845	C.D. 16·11
0	11	11	20·58±2·100		94·95±6·357	
0	9	9	13·38±2·295		98·03±6·210	
0	7	7	17·62±2·516		94·24±5·787	
0	5	5	15·80±2·361		93·66±5·743	
0 (s.h.d.)	13	13	4·65±0·830		32·88±2·22	
2	13	11	6·15±1·039		33·91±2·441	
4	13	9	11·42±1·420		50·53±3·003	
6	13	7	14·67±1·694		69·47±3·686	
8	13	5	14·93±1·590		98·09±4·127	

the acentric fragments and the minutes. The chromotid aberrations were not taken into consideration because relatively few of them were produced with any of the treatments. Several hundred cells, without any selection, were analysed in each case for the scoring of the aberrations.

The observations in respect of each of the treatments are summarised in Table I. These show that when the radiation dose is given in two fractions with an interval of 2 hours between them, the frequencies of both types of aberrations are considerably reduced compared with those resulting from the continuous dose. When the interval between the fractions is extended to 4 hours, a reduction which however is less pronounced, can still be observed. As the gap between the fractions is still further increased, the aberrations frequency approaches more closely the breakage yield due to the continuous dose. The data thus show that the drop in the number of chromosome aberrations when the radiation dose is spread over two fractions with a relatively short interval between them is followed by a recovery which appears to reach a maximum for the reunion when the interval extends to 8 hours. Further, the aberration frequencies due to the single half dose of 1,200 *r*, also indicated in Table I, make it clear that the yield, on fractionation, drops below twice this value and rises above it, following the process of reduction and recovery.

A correct interpretation of results from investigations designed to study the dose fractionation effect, is rendered difficult because of the fact that radiation sensitivity of the chromosomes, as also the conditions determining restitution and reunion of breaks, are known to vary during the course of the nuclear cycle.[3] The possibility that the changed frequency of the aberrations following fractionation of the dose might be due to the altered sensitivity or the different conditions for restitution and reunion in the two samples, has therefore to be taken into consideration. The observations in Table I show that neither the frequency of the reunions nor that of the chromosome breaks differ significantly when the continuous dose is given to cells at different stages of the resting condition, except in the case of the sample fixed 9 hours after irradiation, in which the frequency of reunions is slightly reduced. It is obvious that neither the extent of this reduction, nor the stage at which it occurs, suggest a possible change in the reduction-recovery trend of the dose fractionation data.

In view of these considerations, it may be supposed that the differences in the frequencies of the reunions and breaks due to the continuous and the fractionated dosages are primarily a function of dose fractionation.

The initial drop following fractionation of the dose as described here is in full agreement with the corresponding observations of Sax and Luippold,[4] Lane[5] and others[6,7] on *Tradescantia*. Sax interpreted this drop as due to a possible property of the broken ends to reunite, restitute or heal within an hour, usually within a few minutes of the breakage and therefore failing to take part in reunions with those produced by the second fraction given after an interval of more than one hour.

Experimental observations opposed to this interpretation of the decline in the breakage yield were first described by Lane (*loc. cit*). These showed that the initial drop was followed by a recovery as the interval between the fractions was extended beyond 4 hours. This recovery which is obviously not consistent with the theory of rapid reunion and restitution was not apparent in the experiments of Sax and a number of other authors. It has been suggested that the different conditions of experiments may be responsible for the contradictory results.

The present study in barley indicates a recovery in the frequency of aberrations similar to that reported for *Tradescantia*, although the two differ in their timings. The extent of this recovery suggests that the breaks due to first fraction remain open for reunion with those produced by the second, several hours later. Similarly the extent of the drop preceding the recovery is not fully explained by the hypothesis of rapid reunion and restitution. An alternative explanation of the dose fractionation results, however, is not very evident. Lane has suggested that the drop and recovery are due to a physiological effect of the radiation treatment, which makes the chromosomes temporarily less sensitive to subsequent irradiation.

We are grateful to Dr. B. P. Pal and Dr. S. M. Sikka for their kind interest and encouragement. Our thanks are also due to Dr. M. S. Swaminathan for a discussion of the results.

1. Sax, K., *P.N.A.S.*, 1939, **25**, 225.
2. —, *Genetics*, 1940, **25**, 41.
3. Lane, G. R., *Heredity*, 1951, **5**, 1.
4. Sax, K. and Luippold, H., *Ibid.*, 1952, **6**, 127.
5. Lane, G. R., *Ibid.*, 1952, Suppl. **6**, 23.
6. Bora, K. C., *J. Genet.*, 1954, **52**, 140.
7. Fetner, R. H., *Radiation Res.*, 1956, 510.

THE PROBLEM OF THE BLAST DISEASE OF RICE*

T. S. SADASIVAN

(University Botany Laboratory, Madras)

DESPITE much work done on the blast disease of rice caused by *Piricularia oryzæ* Cav. there is still a lacuna in our knowledge on the physiology of the fungus and its host-parasite relationships.

Our investigations and those of others indicate that the vitamins thiamine and biotin and the heavy metals Fe, Zn, Mn and, to a certain extent, Cu are indispensable for growth and sporulation of the fungus *in vitro*[1] and considerably greater amounts of the nutrilites are needed for sporulation than for growth.[2] Taking thiamine alone, the fungus does not need the intact molecule but only the pyrimidine fraction on a sucrose-nitrate medium. Curiously, however, the biosynthetic abilities of the organism towards thiamine seems to depend upon the nature of the substrate sugar. With maltose, pyrimidine is equivalent to the whole thiamine molecule, whereas with glucose as the carbon source, pyrimidine is not fully effective thus indicating that pyrimidine is probably active only when present with the labile γ form of glucose. The utilization of pyrimidine under these restricted conditions appears to be a temperature phase when disaccharides are hydrolysed.[3,4] Inorganic nitrogen metabolism of the pathogen *in vitro*[5] shows that while the fungus uses NO_3 nitrogen with ease, inorganic NH_4 nitrogen is not assimilated due to the development of a high physiological acidity in the case of ammonium salts of strong acids like ammonium sulphate. Should this acidity be neutralized with $CaCO_3$ or if certain organic acids of the Kreb's cycle like succinic, fumaric and citric acids are added in small amounts, normal growth of the fungus is evident with ammoniacal nitrogen. Thus, the action of the organic acids appears to be two-fold : either they act as buffers or enter the metabolic cycle to combine with the ammonium ions to form the primary amino acids.

Among the metabolic products of interest synthesized by this fungus *in vitro* is the identification of the toxin piricularin and α-piconilic acid.[6] What role thiamine and the specialized nitrogen sources this fungus seems to prefer play in the synthesis of these toxins is a point of interest and offers great scope for future investigations.

Little is known of the biologics of parasitism of *Piricularia oryzæ* and normal suscepts fail to take infection under temperatures of 24-26° C. and above 95% humidity which have been found optimum for infection. Quite recently we have succeeded in demonstrating that a low night temperature (about 20° C.), is intimately connected with host susceptibility in altering the nitrogen metabolism of the host and favouring amide synthesis especially glutamine, by facilitating greater nitrate reduction.[7] At high nycto-temperatures, nitrate reduction is possibly low and the photosynthates are mainly utilized in the building up of complex cell-wall materials which might combine with high concentrations of silicon observed in rice plants and form organo-silicon complexes which are relatively resistant to attack by extra-cellular enzymes of *P. oryzæ*.[8] Earlier results on the nitrogen metabolism of the rice plants, resistant and susceptible to the blast disease,[2] viewed in light of our recent findings indicate that the susceptible types possess a more keyed up enzyme system(s) for the efficient utilization of the absorbed N than the resistant ones. This appears to be true of glutamine synthesis in the two types.

Earlier investigations on the cuticular excretions of the rice plant in relation to disease incidence showed that a variety of amino and organic acids are found on the leaf blades of rice.[9] Recent studies have, however, revealed that among the metabolites, glutamine crystallizes on the leaf surfaces in sizeable quantities under conditions of heavy nitrogenous manuring and markedly stimulates the germination of *Piricularia* spores.[10]

Current investigations on the resistance of rice to *Piricularia* indicate that resistance can be broken down with maleic hydrazide, but only if the plants have been subjected to a low nycto-temperature (20° C.).[11] This only strengthens our view that the resistance-susceptibility mechanisms in relation to the blast disease though primarily gene controlled, is intimately interrelated with the physiology of the host as influenced by the environment, particularly low nycto-temperatures.

All these experimental findings indicate exacting growth requirements of the fungus

* Summary of lecture delivered on the 29th December 1958, to the 24th Annual Session of the Indian Academy of Sciences, Baroda.

in vitro and possibly *in vivo*. It is, therefore, logical to consider the blast fungus as one with a higher level of specialization than a mere facultative saprophyte.

1. Appa-Rao, A., Saraswathi-Devi, L. (Miss) and Suryanarayanan, S., *J. Indian bot. Soc.*, 1955, **34**, 37–42.
2. Appa-Rao, A., *Doctoral Thesis*, University of Madras, 1956.
3. Suryanarayanan, S., *Proc. Ind. Acad. Sci.*, 1958, **48**, 154–88.
4. —, *Phytopath. Z.*, 1958, **33**, 341–48.
5. Appa-Rao, A., *Experientia*, 1956, 215–18.
6. Tamarli, K. and Kaji, J., *J. Agric. Chem. Soc. Japan*, 1954, **28, 254–58.
7. Suryanarayanan, S., *Proc. nat. Inst. Sci. India*, B (In press).
8. Volk, R. J., Kahn, R. P. and Weintraub, R. L., *Phytopathology*, 1958, **48**, 179–84.
9. Subba-Rao, N. S. and Suryanarayanan, S., *Curr. Sci.*, 1957, **26**, 186–87.
10. Suryanarayanan, S., *Ibid.*, 1958, **27**, 447–48.
11. —, Unpublished.

** Not seen in original.

A VERSATILE RESEARCH REACTOR WITH A NEW TYPE OF CORE

THE TRIGA, an American multi-purpose research reactor has been specially designed for research laboratories and academic institutions. It can be used for research and training, as well as for isotope production, and its makers, General Dynamics, claim that it is accident-proof.

The fuel elements consist of a solid mixture of uranium of 20% enrichment and zirconium-hydride moderators. Zirconium hydride is a remarkable substance because it has as much hydrogen per unit volume as water and at the same time has metallic properties.

The core is at the bottom of a well 20′ deep and 6′ in diameter. Shielding is provided by about 16′ of water above the core, which gives sufficient protection from radiation and allows the removal of specimens while the reactor is operating. The water also allows the visual observation of the core and control rods during operation and provides a large volume of irradiation space.

Two safety rods and one regulating rod are used to control the power level and shut off the reactor. The driving mechanism for them is located on a steel grating at ground level.

A graphite reflector about 1′ thick is provided on all sides and the bottom of the core. It is sealed in a welded aluminium can to prevent water from entering the graphite. Six inches of graphite are also included in the top end of the fuel elements to provide a top reflector directly over the core.

Because of the inherent safety of the reactor, there is no need for an air-tight containment building.

TRIGA produces radio-isotopes of 62 of the first 82 elements and is particularly useful for making short-lived isotopes. There are many uses for these isotopes as in medicine where they can replace those with longer lives. For example, the 25-minute iodine-131 to lower the effective dose received by the patient for an equivalent amount of treatment. In industry, short-lived isotopes are valuable in process control.

Radiochemical work, including hot atom chemistry, can also be carried out with TRIGA.

According to the makers, TRIGA is capable of supporting a broad programme of teaching and research, including such subjects as reactor engineering, the study of isotope production and application, instrumentation through the use of isotopes, in addition to its wide range of medical and industrial applications. (*Atoms for Peace Digest*, Aug. 22, 1958.)

CHROMIUM "BULLETS" FOR CANCER

TINY "bullets" of radioactive chromium metal to fight against cancer are now available to medical science as a result of U.S. Bureau of Mines research in metallurgy.

The "bullets" are actually small metal cylinders, a tenth of an inch long and only a thirtieth of an inch in diameter, cut from strands of high-purity chromium wire. The wire is produced at the North-west Electro-development Laboratory of the Bureau of Mines in Albany, Oreg., with techniques developed by Bureau metallurgists.

Exposed to neutrons, some of the atoms in the chromium cylinder change to the radioactive isotope chromium 51. Tests indicated that chromium 51 offers many advantages over previously used radioactive "bullets" made from radiogold, radiocobalt or radiotantalum. Radiochromium is eminently suitable for permanent implantations in tissue for the treatment of cancer. The "bullet" can either be shot into the cancerous tissue by an "implantation gun", or they are sown into the malignant area.—*SASLO Science News Selections*—285.

LETTERS TO THE EDITOR

MAGNETIC ANISOTROPY OF EUROPIUM SULPHATE OCTAHYDRATE AND ASYMMETRY OF ITS CRYSTAL FIELD

FRANK[1] has discussed theoretically the stark splitting of the energy levels of Eu^{+++} ion in crystals under the influence of the crystalline electric field and its influence on the magnetic behaviour of the ion. She finds that a field of cubic symmetry in the neighbourhood of Eu^{+++} ion gives a good fit with experimental mean effective magnetic moments between 83° K. to 343° K. as obtained by Selwood[2] and that the field of rhombic symmetry has very little effect.

It may be pointed out here that owing to the averaging out, the effect of the non-cubic part of the field, is not so conspicuous with crystal powder value, as it reveals only the effect of the cubic part. It is the measurements with single crystals that can reveal both cubic and non-cubic portions of the field. Hence we have recently measured the principal magnetic susceptibilities of single crystals of $Eu_2(SO_4)_3\ 8H_2O$ belonging to the monoclinic class with, most probably, 8 molecules in the unit cell.[3]

One direct consequence of a field of cubic symmetry would be a complete magnetic isotropy for the crystal and the observed deviation from isotropy would give us some idea of the deviation of the crystal field from cubic symmetry. Our measurements of $\Delta\chi$ by the method of Krishnan and Banerji[4] and $\bar{\chi}$ by a quartz microbalance[5] show that the magnetic anisotropy $\Delta\chi/\bar{\chi}$ is $0{\cdot}126 \pm {\cdot}001$, where $\Delta\chi$ is the maximum anisotropy and $\bar{\chi}$ is the mean susceptibility.

This value of the magnetic anisotropy is not small. When we remember that group of atoms associated with each Eu^{+++} ion in the crystal should have at least this anisotropy (in all probability, the anisotropy will be more as the different groups present in the unit cell of the crystal will not, in general, be oriented parallel to each other), and that it is the anisotropy of the above group—and not that of the crystal—which corresponds to the asymmetry of the field under consideration, it is easy to realize that the deviation from the cubic symmetry should be quite marked.

Details will be published elsewhere.

Agra College, A. MOOKHERJI.
Physics Laboratory, D. NEOGY.
July 14, 1958.

1. Frank, *Phys. Rev.*, 1935, **48**, 771.
2. Selwood, *J. Am. Chem. Soc.*, 1933, **55**, 4869.
3. Zachariasen, *J. Chem. Phys.*, 1935, **3**, 197.
4. Krishnan and Banerji, *Philos. Trans.*, 1935, **234**, 265.
5. Bose, *Ind. Jour. Phys.*, 1947, **21**, 275.

THE CHARACTERISTIC NUCLEAR SCATTERING OF 289 MeV. PROTONS

To correlate the experimental data on the nuclear scattering of 90 Mev. neutrons, Fernbach, Serber and Taylor[1] have introduced the optical model of the nucleus. In this model, a nucleus is represented by a sphere with a uniform distribution of nuclear matter characterised by a complex refractive index for the nucleon wave given by

$$n = 1 + \left(\frac{\bar{n}}{k}\right)\rho \qquad (1)$$

where $\bar{n} = \bar{n}_1 + i\,\bar{n}_2$ and ρ is the nucleon density. It has been shown by Gatha, Shah and Patel[2] that the experimental angular distributions for the nuclear scattering of 340 Mev. protons by light elements can be reasonably represented by a characteristic angular distribution given by

$$|\,g(\bar{S})\,| = \frac{[\sigma(\bar{S})]^{1/2}}{2kA}$$

$$|\,g(\bar{S})\,| = \sum_{p=1}^{3} a_p \exp.(-b_p\bar{S}^2) \qquad (2)$$

where $\bar{S} = S \times A^{1/3}$ with $S = 2k \sin\left(\frac{\theta}{2}\right)$, while

$a_1 = 0{\cdot}01\ mb$, $b_1 = 0{\cdot}01 \times 10^{-26}\ cm.^2$,
$a_2 = 0{\cdot}17\ mb$, $b_2 = 0{\cdot}07 \times 10^{-26}\ cm.^2$,
$a_3 = 1{\cdot}03\ mb$, $b_3 = 0{\cdot}34 \times 10^{-26}\ cm.^2$

Using the experimental differential scattering cross-sections of Bjorklund, Blandford and Fernbach[3] for the nuclear scattering of 289 Mev. protons, $|\,g(\bar{S})\,|$ have been calculated for carbon and aluminium. The calculated $|\,g(\bar{S})\,|$ are plotted against $\bar{S}$ for these elements in Fig. 1.

The theoretical $|g(\bar{S})|$ calculated from equation (2) is also plotted in Fig. 1. It is interesting to observe that the same characteristic

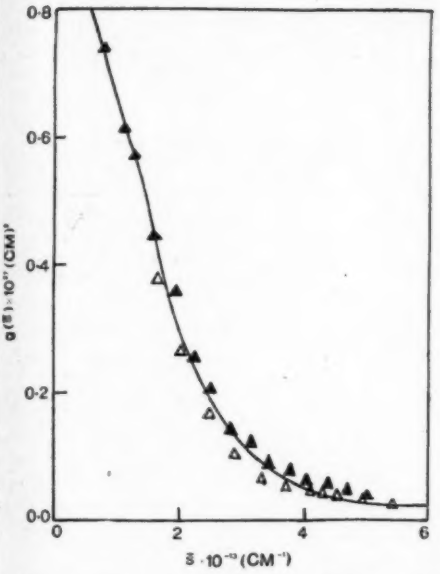


FIG. 1. The characteristic angular distribution for the nuclear scattering of 340 Mev. protons. Closed triangles and open triangles represent the calculated $|g(\bar{S})|$ for Carbon and Aluminium at 298 Mev.

angular distribution exists even at this energy. This strengthens the original assumption that there exists a characteristic nuclear density distribution for light elements.

Bhavan's College, Andheri, Bombay-41; and Institute of Science, Mayo Road, Bombay-1, *September* 17, 1958.

G. Z. SHAH.
K. M. GATHA.

1. Fernbach, S., Serber, R. and Taylor, T.B., *Phys. Rev.*, 1950, **75**, 1352.
2. Gatha, K. M., Shah, G. Z. and Patel, N. J., *Proc. Phys. Soc.*, 1954, **67 A**, 773.
3. Bjorklund, F., Blandford, I. and Fernbach, S., *Phys. Rev.*, 1957, **108**, 795.

SODIUM METAPERIODATE OXIDATION OF STARCHES

OXIDATION with periodate ion resulting in 1, 2-glycol scission, is one of the most widely used reactions in carbohydrate chemistry. Since its discovery by Malaprade in 1928, the use of the reaction has been made in the field of organic chemistry. Later on Jackson and Hudson[1] used this reaction for the structural studies of starch. Different workers[2,3] showed that there was greater tendency towards over oxidation at or above the temperature 20° C. Grangaard *et al.*[2] have recommended that pH 2·5 should be maintained during the period of oxidation.

Periodate oxidized starch may be useful as a polymeric material in itself or after modification. The percentage conversion of anhydrous glucose units can vary from 0-100. For 100% oxidation of starch, 1·05 moles of sodium metaperiodate per anhydrous glucose unit was used but for lesser degrees of oxidation only the theoretical amount of reagent was used. Neglecting any abnormal periodate reduction by the end units of amylose or reducing end groups of amylopectin, the reduction of the oxidant should be about 1·03 moles per anhydrous glucose unit of starch when the oxidation is carried out to completion.

In this work the starches have been oxidized for different periods by mild oxidant $NaIO_4$ at room temperature (27-28°) and their physico-chemical properties have been studied.

The oxidation of starch was carried out by $NaIO_4$ (2%) and the dialdehyde units were calculated according to the method of Fleury and Lange.[4] Alkali labile-value was determined according to the method of Schoch and Jensen.[5] Viscosity measurement of the oxidized

TABLE I

Physico-chemical properties of periodate oxidized starches

Period for oxidation (hrs.)	Alkali-labile value	Dialdehyde units %	% Hydrolysed starch at optimum conditions	
			Malt-diastase	Pan-creatin
Andropogon sorghum, Brot. (Jowar)				
1 ..	42·0	26·1	..	..
3 ..	50·0	31·5	..	..
8 ..	56·0	43·0	..	..
13 ..	67·2	61·0	..	..
18 ..	71·5	87·3	..	..
22 ..	78·8	102·2	18·9	23·8
Phaseolus mungo, Linn. (Math.)				
1 ..	43·5	35·0	..	..
3 ..	49·8	40·5	..	..
8 ..	55·6	55·0	..	..
13 ..	63·0	70·0	..	..
18 ..	70·2	88·0	..	..
22 ..	79·5	102·3	18·9	23·0

samples was done in 1 N KOH at 30° C. with the help of Ostwald's viscometer.

From Table I it can be marked that the oxidation of starches increases with the increase in the period of oxidation. It was completed at 22 hours' period.

Table II furnishes the data of physico-chemical properties of different starches oxidized by observed that the digestibility of oxidized starches has been decreased.

Table III gives the data of physico-chemical properties of the untreated starches.

Authors' thanks are due to Prof. J. G. Chohan for his interest in the work, and Shri P. T. Shah for the help in the work.

TABLE II

Physico-chemical properties of periodate and hypochlorite oxidized starches
(Oxidized at optimum conditions)

Name of starch	Viscosity (η)	Alkali-labile value		Oxidation		% Hydrolyzed starch at optimum conditions			
						(Malt-diastase)		(Pancreatin)	
	(*a*)	(*a*)	(*b*)	(*a*)*	(*b*)†	(*a*)	(*b*)	(*a*)	(*b*)
Pennisetum typhcideum, Rich.	1·010	80·8	18·4	102·2	268·8	18·7	25·3	23·5	27·5
Panicum miliaceum, Linn.	0·935	85·6	20·0	100·2	281·6	19·2	23·5	23·9	27·4
Cicer arietinum, Linn.	1·130	75·2	15·0	100·3	300·5	18·7	20·5	23·5	23·2
Phaseolus aconitifolius, Jacquin.	1·030	78·3	15·3	101·5	295·0	19·5	21·5	23·9	23·8

(*a*) Are the results obtained for sodium metaperiodate oxidized starches.
(*b*) Are the results obtained for sodium hypochlorite oxidized starches.
(*a*)* Dialdehyde units.
(*b*)† Oxygen uptake in milligram by 100 g. of starch.

TABLE III

Name of starch	Viscosity (η) in 1 N KOH	Alkali-labile value	% Hydrolyzable starch	
			Malt-diastase	Pancreatin
Pennisetum typhcideum, Rich. ..	1·542	12·2	29·9	30·2
Panicum miliaceum, Linn. ..	1·290	11·6	30·4	31·8
Cicer arietinum, Linn. ..	1·575	12·8	28·2	33·0
Phaseolus aconitifolius, Jacquin. ..	2·200	9·6	30·9	32·4

$NaIO_4$ and NaOCl. The values denoted by (*a*) and (*b*) are of $NaIO_4$ and NaOCl oxidized starches respectively. These samples have been used for the studies of their physico-chemical properties. The alkali-labile values of $NaIO_4$ oxidized samples are higher than those of NaOCl oxidized samples. From the viscosity measurements it is noted that there is decrease in the (η) due to the oxidation of starches. Digestibility of the oxidized starches has been studied with two enzymes, namely, (*a*) malt-diastase, and (*b*) pancreatin at 38° C. It is

Chemistry Dept., R. D. PATEL.
Sardar Vallabhbhai R. P. PATEL.
Vidyapeeth, R. S. PATEL.
Anand, *May* 27, 1958.

1. Jackson, E. L. and Hudson, C. S. *J. Amer. Chem. Soc.*, 1958, **60**, 989.
2. Grangaard, D. H., Gladding, E. K. and Purves, C. B., *Paper Trade J.*, 1942, **115** (7), 41.
3. Anderson, D. M. W., Greenwood, C. T. and Hirst, E. L., *J. Chem. Soc.*, 1955, 225.
4. Fleury, P. and Lange, J., *J. Pharm. Chem.*, 1933, **17**, 107.
5. Schoch, T. J. and Jensen, C. C., 1940, **12**, 531.

TRANSFERENCE NUMBERS OF ZINC IODIDE IN DILUTE AQUEOUS SOLUTIONS

THE earlier papers[1–2] have presented data on transference numbers of some electrolytes in dilute aqueous solutions. This paper extends this investigation to include zinc iodide. Our present knowledge of the transference number of the zinc ion in zinc iodide solution is mainly due to Egan and Partington[3] and Stokes and Levien[4] by the Hittorf and E.M.F. methods respectively. The results are not in agreement. It was, therefore, considered reasonable to obtain independent data of the transference number of this bi-univalent electrolyte by the moving boundary method.

The mode of experimentation was the same as described previously.[1] The selection of the material for the electrode is of great importance. Gas must not be evolved at the cathode which is the closed side, since any volume change occurring there will affect the velocity and sharpness of the falling boundary. Preparation of non-gassing electrodes is also necessary in the Hittorf method.[5]

only at extreme dilution. In these experiments the transference numbers fall gradually between the concentration 0·01 N to 0·2990 N by only 15%.

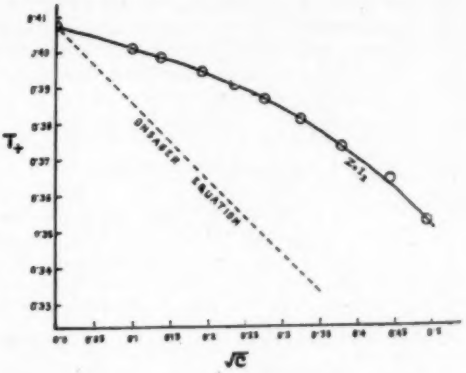


FIG. 1. The Onsager Limiting Slope: Comparison with Experimental Results in ZnI_2.

It is considered that Hittorf method of finding transference number as adopted by Egan and Patrington and Hittorf[4] (1859) with this

TABLE I

Con. of ZnI_2 in gm. equi./litre (C)	$\sqrt{C}$	Constant Current	Con. of Indicator sol. NaCl	Transference Number of the cation 25° C.
0·005 N	0·07071	0·3 mA	0·0045 N	0·40944
0·01013 N	0·10064	0·3 mA	0·0095 N	0·39972
0·0202 N	0·14213	0·5 mA	0·018 N	0·39758
0·0402 N	0·20005	0·6 mA	0·0385 N	0·39444
0·06012 N	0·24497	0·8 mA	0·0570 N	0·39102
0·08110 N	0·28480	1·0 mA	0·080 N	0·38683
0·1132 N	0·33644	1·0 mA	0·110 N	0·38092
0·1501 N	0·38743	1·5 mA	0·150 N	0·37240
0·2031 N	0·45067	2·0 mA	0·200 N	0·36421
0·2453 N	0·49527	2·0 mA	0·250 N	0·35090
0·2990 N	0·54681	4·0 mA	0·300 N	0·34110

Fig. 1 represents graphically the data given in Table I. The transference number at zero concentration to which the curve in Fig. 1 has been extrapolated was deduced from the most recent published data[6] available on limiting ionic conductances for zinc and iodide ions in water at 25° C. The transference number at infinite dilution for zinc ion in zinc iodide is, therefore,

$$T_{Zn}^{\circ} = \frac{\lambda_+^{\circ}}{\lambda_+^{\circ} + \lambda_-^{\circ}} = \frac{53{\cdot}0}{53{\cdot}0 + 76{\cdot}8} = 0{\cdot}40831.$$

Thus the value of the limiting slope derived from Onsager equation for zinc iodide is $-0{\cdot}21867$. The experimental curve in Fig. 1 merges into the limiting slope from above

electrolyte does not work satisfactorily in dilute solutions and give results which are outside the limit of error. Similar views have been expressed by other investigators.[4,7,8] The results obtained by Stokes and Levien by E.M.F. method appears to be in agreement with the present investigation in dilute solution but could not be verified at higher concentration. The experimental curve obtained by Stokes and Levien for the transference number in zinc iodide is not smooth and has not been compared at low concentration with the Onsager limiting slope. The value of 0·410 for the limiting transference number assumed by Stokes and Levien is also slightly higher than the published data.

From thermodynamic studies, Bates[9] has shown that zinc iodide is a normal electrolyte in aqueous solutions more dilute than 0·8 M. Stokes and Levien have also reported normal behaviour of this electrolyte below 1 M by their measurements of transference numbers and activity coefficients. These observations seem to be in accord with the results obtained in this investigation.

Dept. of Chemistry, J. N. SAHAY.
Ranchi College,
Ranchi, *July* 14, 1958.

1. Sahay, J. N., *Curr. Sci.*, 1958, **27**, 247.
2. —, *J. Sci. Indust. Res.* (Communicated).
3. Egan, D. M. and Partington, J. R., *J. Chem. Soc.*, 1945, 191.
4. Stokes, R. H. and Levien, B. J., *J. Amer. Chem. Soc.*, 1946, **68**, 1852.
5. Kerker, M. and Espenscheid, W. F., *Ibid.*, 1958, **80**, 776.
6. Conway. B. E., *Electrochemical Data*, Elsevier Publishing Co., London, 1952, 145.
7. Longsworth, L. G. and MacInnes, D. A., *J. Amer. Chem. Soc.*, 1938, **60**, 3070.
8. Dawson, L. R. and Berger, C., *Ibid.*, 1957, **79**, 4269.
9. Bates, R. G., *Ibid.*, 1938, **60**, 2983.

THE PREPARATION OF URANIUM TETRAFLUORIDE

URANIUM tetrafluoride is generally prepared by the high temperature treatment of oxides of uranium with anhydrous HF[1] or Freons[2,3] and secondly by the action of HF[1,4] on the solutions of uranium (IV) salts, the reduction of uranium (VI) to uranium (IV) for the purpose being brought about by the use of $SnCl_2$. The present method has been to avoid high temperature treatment as well as the use of foreign substances in the preparation of the tetrafluoride. In this method uranium (IV) oxyformate prepared by the method of photolysis,[5] as distinct from the method adopted by Rosenheim,[6] formed the starting material. Thus the entire process of the preparation of the tetrafluoride is confined to uranium, formic acid and hydrofluoric acid.

When 30-40% HF (E. Merck. G.R. quality) is added to finely powdered uranium (IV) oxyformate taken in a platinum crucible, uranium tetrafluoride is formed with evolution of heat. It was allowed to stand for an hour when the supernatant liquid was decanted off. The bright green precipitate obtained was next dried at 100° C. The analysis of the tatrafluoride was carried out by dissolving a weighed quantity of the substance in 8 N HCl, precipitating uranium as hydrated oxide with NH_4OH. The precipitate was filtered and washed. The hydrated oxide was next heated in a platinum crucible to U_3O_8 and weighed, from which the molecular weight was computed. The filtrate was used for the estimation of fluorine as CaF_2.[7] Uranium (IV) was also estimated by the method adopted by Hatt.[8] The results of several determinations which yielded concurrent values showed that the compound prepared has the formula UF_4, 1·5 H_2O.

The preparation of the anhydrous tetrafluoride was next attempted by heating the compound at 150-60° C. in vacuum. The analysis of the compound obtained after heating for three to four hours indicated slight decomposition.

As mentioned above, the reaction of HF with uranium (IV) oxy-formate is an exothermic one. Our next attempt, therefore, is to utilise the exothermicity of the reaction in preparing anhydrous tetrafluoride at comparatively low temperature by treating anhydrous uranium (IV) oxy-formate with anhydrous hydrofluoric acid or freons.

The photolytic preparation of the compound will be published elsewhere.

Department of Chemistry, BALARAM SAHOO.
Ravenshaw College, D. PATNAIK.
Cuttack,
August 20, 1958.

1. Seaborg, G. T. and Katz, J. J., *The Actinide Elements*, First Edn., 1954, 147–48.
2. Booth, H. S., Krasny-Ergen, W. and Heath, R. E., *J. Amer. Chem. Soc.*, 1946, **68**, 1969.
3. Krishna Prasad, N. S. and Dadape, V. V., *Curr. Sci.*, 1957, **26**, 210.
4. Ruff, O. and Heinzelmann, A., *Z. Anorg. Chem.*, 1911, **72**, 64.
5. Sahoo, B. and Patnaik, D., *Curr. Sci.*, 1958, **27**, 243.
6. Rosenheim, A. and Kelmy, M., *Z. Anorg. U. allgem. Chem.*, 1932, **206**, 34–43.
7. Vogel, A. I., *A Text-book of Quantitative Inorganic Analysis*, 2nd Edn., 1951, 494–95.
8. Hatt, E. C., *Zeit. Physik. Chem.*, 1918, **92**, 513.

DETERMINATION OF ASCORBIC ACID (VITAMIN C) BY BROMATE—AN AMPEROMETRIC METHOD

RECENTLY we have shown[1] that micro- and milligram quantities of hydrazine can be estimated by direct titration with standard potassium bromate. The end-point is detected amperometrically using a rotated platinum microelectrode. Preliminary experiments revealed that the bromate method can be suitably adopted for the estimation of ascorbic acid (Vitamin C).

$$HBrO_3 + C_6H_8O_6 + 4H^+ \rightarrow HBr + C_6H_6O_6 + 3H_2O$$

In the usual procedure, *p*-ethoxychrysoidine is

used as a reversible indicator but when titrating dilute solutions of ascorbic acid, the indicator error becomes considerably greater and the sensitivity appreciably low.[2] Under these circumstances, amperometric end-point is ideal as it is independent of visual colour changes. Using a sensitive galvanometer (0-20 microamperes), an applied e.m.f. of zero (*versus* S.C.E.), and a rotating platinum electrode, direct titration of ascorbic acid with standard bromate was found feasible in solutions 2·0 N in hydrochloric acid and 0·05 M in potassium bromide. The diffusion current, almost zero in the beginning, increases linearly with the increments of reagent added after the equivalence point. A reversed L-type of graph is obtained and the intersection of the two straight lines corresponds to the precise end-point. It is possible to estimate accurately quantities of ascorbic acid as low as 0·1 mg. per 100 ml. of the solution. A detailed investigation on the ascorbic acid-bromate reaction in different acid environments, at various applied potentials and by varying other experimental factors is now being carried out and the results will be published at a later stage.

Our sincere thanks are due to Dr. Philip W. West, Boyd Professor of Chemistry, for research facilities and interest in the work.

Coates Chem. Labs., Louisiana State University, Baton Rouge, 3, La., U.S.A.,
August 20, 1958.

BHARAT R. SANT.*
ANIL K. MUKHERJI.*

* Assistant Professors (Visiting) at Louisiana State University.

1. Sant, B. R. and Mukherji, A. K., *Analyt. Chim. Acta* (Under publication).
2. Schulek, E., Kovacs, J. and Rozsa, P., *Z. Anal. Chem.*, 1941, **121**, 17.

COLOURED BARYTES FROM KHAMMAM (ANDHRA STATE)

COLOURED barytes have not been thoroughly studied with reference to the origin of their colours. Recently, while we were conducting a geochemical survey of barium-bearing belt lying at a distance of about 8 miles to the east of Khammam Town we noticed the presence of black, grey, green and dark-brown barytes amidst large deposits of the usual off-colour barytes.

The colour of the off-colour barytes which is mostly cream or light-brown is due to iron and is largely due to surface coating. But the case of other coloured barytes is entirely different. They present interesting facts showing that the colour is due to the presence of elements like lead, copper, chromium and carbon.

It has been conclusively established both by physical and chemical examination that in most cases the colour of the black and grey barytes is due to the presence of finely distributed particles of galena (PbS). In some, carbon was also present along with galena contributing partly to the black and grey colour of barytes. In these barytes the lead content normally varies from 0·3 to 1% and sometimes even upto 3%. Presence of lead as galena was also noticed at a number of points in the barytes deposits as veins and as segregations. Work is now in progress to establish the cause of colour of green and dark-brown barytes.

Essen & Co., Bangalore-3,
October 11, 1958.

N. JAYARAMAN.
M. R. G. SHARMA.

ANISOTROPY IN BEDDED LIMESTONES

LABORATORY measurements of elastic constants of rocks are based on the assumption that rocks which are in the nature of polycrystalline aggregates are isotropic for such purposes. Zisman,[1] Idel,[2] Birch and Bancroft[3] and Prasadarao[4] studied the directional variation of velocities of sound in several rocks and came to discordant conclusions. The author[5] has studied the behaviour of rocks and came to the conclusion that most rocks, with no evident bedding or variation of composition, are nearly isotropic. Because of the stratified nature of limestones, it is thought desirable to study the variation of ultrasonic velocities in two directions, namely, (*a*) perpendicular to the bedding plane working with a section taken parallel to the bedding plane and (*b*) along the bedding plane working with a section taken perpendicular to the bedding plane. In the present investigation six bedded limestones from Shahbad quarries have been taken and ultrasonic velocities (both longitudinal V_L and torsional V_T) have been measured using the pulse technique as described by Krishnamurthi and Balakrishna.[6] Below are given the velocities in m./sec. in sections (*a*) and (*b*) cut from different limestones. These velocities are further verified by the Wedge method.[7]

The results suggest that the velocities in the two directions differ appreciably. This is understandable in stratified rock like bedded

TABLE I

	a		*b*	
	V_L	V_T	V_L	V_T
1	7370	3260	6590	3090
2	6580	3340	6180	3250
3	6260	3140	5890	2940
4	6430	3320	6090	3080
5	6850	3290	6530	3160
6	7010	3420	6780	3260

limestone because of varying stresses acting in the two directions. McCollum and Snell[8] made a similar observation working with stratified formations. The asymmetry observed by them is in accordance with that noted in the present work. Further it appears that many of the departures from isotropy observed at atmospheric pressure are due to differences of compactness in different directions and these are likely to disappear at high pressures.

Geology Department, S. BALAKRISHNA.
Osmania University,
Hyderabad-7, *November* 4, 1958.

1. Zisman, W. A., *Proc. Nat. Acad. Sci.*, 1933, **19**, 653.
2. Ide, J. M., *Ibid.*, 1936, **22**, 81.
3. Birch, F. and Bancroft, *Jour. Geo.*, 1938, **46**, 113.
4. Prasadarao, G. H. S. V., *Proc. Ind. Acad. Sci.*, 1947, **25**, 238.
5. Balakrishna, S., *Curr. Sci.*, 1955, **24**, 117.
6. Krishnamurthi, M. and Balakrishna, S. *Proc. Ind. Acad. Sci.*, 1953, **38**, 495.
7. Bhagavantam, S. and Bhimasenachar, J., *Ibid.*, 1944, **20 A**, 298.
8. McCollum, B. and Snell, F. A., *Physics*, 1932, **2**, 174.

THE RARE R_y CHROMOSOME IN TWO PARSI FAMILIES

SOON after the discovery of the original Rh antigen (D) by Landsteiner & Wiener (1940), several workers made observations about newer and different forms of Rh antibodies and antigens. According to the theory of Fisher (1944), the Rh blood groups depend on three very closely linked loci on a pair of chromosomes which were called the C, D and E loci. Fisher & Race (1946) observed that by the combination of six alleles, *viz.*, C, c, D, d, E and e, there would be eight possible types of Rh chromosomes. Of these, seven types were already detected then, but the R_y (CdE) chromosome was only theoretically postulated, with a frequency probably not more than 0·005. It was van den Bosch (1948) who reported for the first time the Rh genotype R_yr (CdE/cde) in a Belgian family. Since then a few more cases of genotype R_yr have been reported in other countries.

Present Study.—About three hundred sibs belonging to 99 Parsi families were studied for various hereditary characters for the detection of autosomal linkage. Interestingly, the study of the Rh blood groups brought to notice two unrelated persons having the rare R_y chromosome. Both these persons were tested for the presence of the D antigen with a battery of incomplete anti-D sera, and were found to be negative.

It is essential to carry out a family study on the persons of phenotype CcdE in order to determine whether genotypically they are R_yr (CdE/cde), R′R″ (Cde/cdE) or R_yR'' (CdE/cdE), since all these genotypes give the same serological reactions with the usual four anti-sera (—C, —c, —D and —E). Family studies were therefore made on the two R_y cases reported herein. The anti-sera used for the serological tests were anti-C, —c, —D, —E and —e. The possibility of the propositi being of the genotype R_yR'' (CdE/cdE) was ruled out by the positive reaction with anti-e serum.

Family 1.—It became evident from the results obtained, that the propositus was R_yr (CdE/cde) and not R′R″ (Cde/cdE) as both the parents lacked the R′ (Cde) chromosome. The father's genotype was revealed as R_yR_2 (CdE/cDE), he being homozygous EE and that of the mother as R_2r (cDE/cde), she being homozygous cc.

Family 2.—The propositus here also was R_yr and not R′R″. The father's genotype was revealed as R_1r (CDe/cde) and that of the mother as R_yR_1 (CdE/CDe), the R″ (cdE) chromosome being absent in the father who was homozygous ee and in the mother who was homozygous CC. The Rh genotypes in the two families are given in the italics (*see* Figs. 1 and 2).

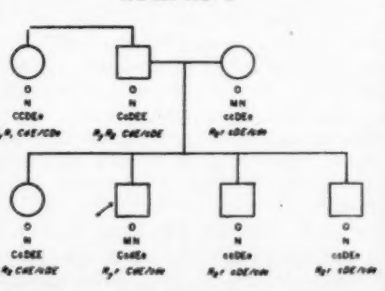


FIG. 1

Investigations of these two families showed that three members (paternal aunt, father and one sib) in family 1, and one member (mother)

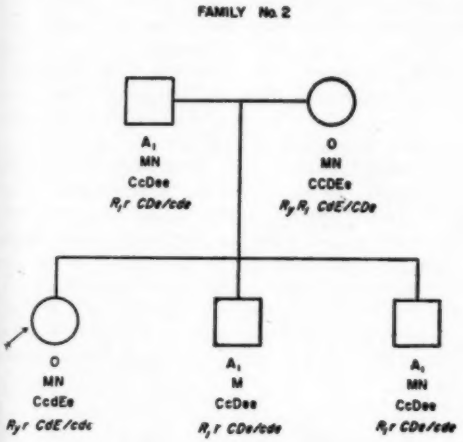


FIG. 2

in family 2 were the carriers of the R_1 chromosome. But for the investigations on the propositi, the R_1 chromosome would not have been detected in these persons by the serological tests with five anti-sera used in this investigation. Paternal aunt in family 1 and mother in family 2 would otherwise have been classified as R_2R_1 (CDE/CDe) which is also a rare genotype.

Occurrence of these two R_1 cases leads us to believe that this rare chromosome may not be so uncommon in the Parsi community. Detailed results of the frequencies of various blood groups and other hereditary characters will be reported elsewhere.

Human Variation Unit, Indian Cancer Research Centre, Parel, Bombay, *August* 2, 1958.

H. R. MASTER.
H. M. BHATIA.
L. D. SANGHVI.

1. Bosch, C. van den, "The very rare Rh genotype R_1 (CdE/cde) in a case of *Erythroblastosis fœtalis*," *Nature*, Lond., 1948, **162**, 781.
2. Fisher, R. A. As quoted by Race, R. R., "An 'incomplete' antibody in human serum," *Ibid.*, 1944, **153**, 771–72.
3. —, and Race, R. R., "Rh gene frequencies in Britain," *Ibid.*, 1946, **157**, 48–49.
4. Landsteiner, K. and Wiener, A. S., "An agglutinable factor in human blood recognized by immune sera for rhesus blood," *Proc. Soc. Exp. Biol.*, N.Y., 1940, **43**, 223.

STERILITY AND THE ASSOCIATED MORPHOLOGICAL CHANGES IN *CALLOSOBRUCHUS ANALIS* (F.) (BRUCHIDAE : COLEOPTERA)

A STERILE strain has been observed for the first time in the stored-grain pest, *Callosobruchus analis* (F.) in a culture jar containing heavily infested *Phaseolus radiatus* "*Mung*" grain. The normal males and females of such a population readily copulate but there are some apparently active but sterile individuals of both sexes which show a general aversion to copulate either with their own kind or with the normal individuals. These sterile individuals were isolated and kept in pairs (a male and a female) but could not be induced to copulate nor did the females lay any eggs. The isolated individuals, however, died after a time.

Certain colour and pattern changes of the elytra and pygidia are intimately associated with sterility. Sterile individuals of both sexes have a similar colour pattern of their elytra and pygidia and the sexes can hardly be distinguished from each other except by their antennæ and genitalia. The normal female has a black or dark brown pygidium with a mid-dorsal row of prominent white setæ (Fig. 1). Each female elytron (Fig. 2) is of a brownish hue and clothed all over with brown setæ except for a glabrous, more or less rectangular, dark area in the middle and a narrow dark strip along its posterior border, the former bounded anteriorly, mesially and posteriorly by a C-shaped band of white setæ. The normal males possess brown pygidia and elytra (Figs. 3 & 4), both covered with light brown setæ. The sterile individuals, on the other hand, possess pygidia (Fig. 5), resembling those of the normal males, and elytra (Fig. 6), resembling those of the normal females with the difference that the general coloration of the elytra and pygidia of the sterile caste is rather dull.

The sterile individuals, when dissected, exhibit the internal reproductive organs to be considerably reduced or poorly developed.

The cause of sterility and the time of the appearance of such sterile generations during the life-history of the individuals are being investigated. According to Wigglesworth (1950), a rise in temperature and a nutritional deficiency at the larval or adult stage affect the fertility in insects. It has been observed by us that *C. analis* normally lays one egg on each grain whereas in undisturbed air-tight jars, in which fresh grains are not added after the

first laying, the insect lays more eggs on the same grain with the result that more than one larva develop in any one grain but not more than one per grain reaches the imago stage and

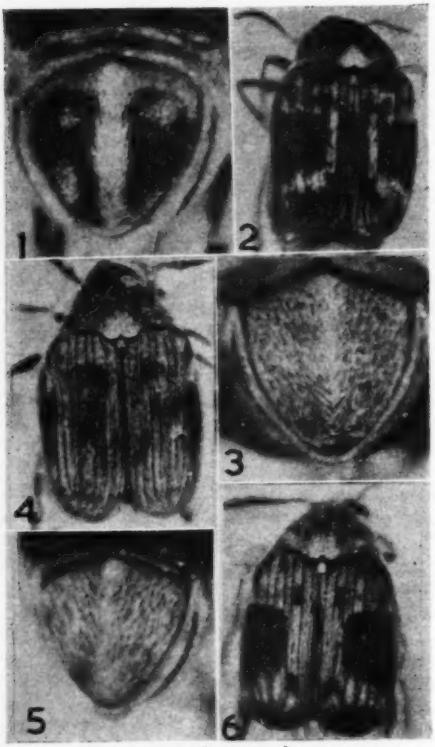


FIG. 1. Normal female (pygidium).
FIG. 2. Normal female (elytra).
FIG. 3. Normal male (pygidium).
FIG. 4. Normal male (elytra).
FIG. 5. Sterile individual, male or female (pygidium).
FIG. 6. Sterile individual, male or female (elytra).

the others die sooner or later. These developing larvæ do not remain inside the grain as they normally do but wriggle out of the grain and may either die or develop into sterile adults in which growth of the reproductive organs is arrested, leading to the peculiar inhibition for mating.

Dept. of Zoology, G. L. ARORA.
Panjab University, H. R. PAJNI.
Hoshiarpur, *June* 17, 1958.

1. Arora, G. L., and Pajni, H. R., *Res. Bull. Panj. Univ.*, 1957, **128**, 453.
2. Southgate, B. J., Howe, R. W. and Brett, G. A., *Bull. Ent. Res.*, 1957, **48**(1), 79.
3. Wigglesworth, V. B., *The Principles of Insect Physiology*, London, 1950.

THE PUPA OF *ALEURODULUS MACULATA* (SINGH)

THE systematics of the Aleurodidæ are chiefly based on the detailed study of the pupa case and many workers in different countries (Bondar,[1] Corbett,[2] Singh,[3] Takahashi,[4] Russell.[5] Menor[6]) have devoted their attention to the external details of the case. But little attention appears to have been paid to the contents of the case, namely, the pupa.

As pointed out by Imms,[7] the family Aleurodidæ forms a link between insects with incomplete metamorphosis and those with complete metamorphosis, inasmuch as a pupal phase intervenes between the last larval instar and the adult. The larval cuticle of the 4th instar is retained as a covering to the pupa, which gradually separates from it. The pupa (Fig. 1) has a distinct head, the thoracic

FIG. 1. Ventral view of female pupa of *Aleurotulus maculata* (Singh).

segments clearly indicated, but abdominal segments not demarcated from one another. It exhibits the various parts of the adult in a formative stage and for lack of space, the antennæ, the legs and the wings are seen in an elaborately folded condition. The wings like those of other Rhynchota appear to develop in an exopterygote fashion. The wing veins are faintly indicated. Since the wings are free from any secondary attachment to the body, the pupa may be regarded as of the exarate type. The compound eyes, constricted in the middle, are well developed and promi-

nent, and are the first parts of the pupa to become pigmented. The mouth parts are mainly represented by the short tubular rostrum containing four minute stylets. The three pairs of spiracles, located in the thoracic region, are conspicuously seen. The developing fat body extends out in the form of a pair of outgrowths, in front of the wing pads, on the sides of the prothorax. It also extends laterally to the posterior end of the abdomen. It is gradually absorbed into the body with the growth of the pupa. These outgrowths are a prominent feature of the pupa of this species. Traces of the valves of the ovipositor are visible at the posterior end of the abdomen below the vasiform orifice. A full account of the pupal anatomy of this form will be published elsewhere.

Department of Zoology, College of Science, Raipur. KARAM SINGH.

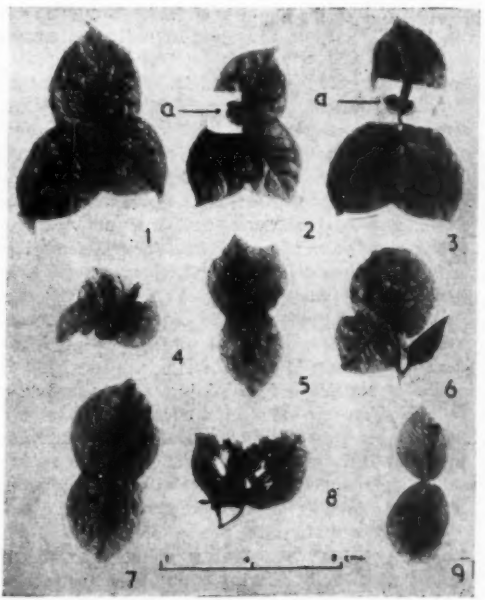
September 8, 1958.

1. Bondar, *The Aleurodidæ of Brazil*, Bahia, 1923.
2. Corbett, G. S., *J.F.M.S. Mus.*, 1935, 17.
3. Singh, K., *Mem. Dept. Agric.*, India, 1931, 12.
4. Takahashi, R., *Rep. Govt. Inst. Formosa*, 1935, 66.
5. Russell, L. M., *J. Washington Acad. Sci.*, 1944, 34.
6. Menor, G., *Eos.*, 1944, 19.
7. Imms, *Text-Book of Entomology*, 1948, 200.

SOME TERATOLOGICAL VARIATIONS IN THE INFLORESCENCES OF *BOUGAINVILLEA GLABRA* CHOISY.

NYCTAGINACEÆ is represented in India by the following three genera, (1) *Bœrhaavia*, (2) *Mirabilis* and (3) *Bougainvillea*, teratological variations have been reported in all the three. In *Bœrhaavia rependa* Willd., Singh and Sinha[1] observed the fasciation of vegetative leaves (one leaf homologue of two normal leaves). Similar observation was made by Singh[2] in *Mirabilis jalapa* Linn. also. In *Bœrhaavia rependa* Joshi and Rao[3] found that instead of two bracteoles, there are sometimes five bracteoles forming an involucre covering the perianth in the bud condition. In *Bougainvillea buttiana* Holttum and Standley, Marigowda[4] observed the suppression of perianth resulting in a production of imperfect flowers. The variations found in a variety of *Bougainvillea glabra* Choisy. growing in Lucknow are recorded below.

1. The cymose inflorescence usually consists of three bracts, each bearing a flower in its axil (Fig. 1). In some inflorescences, however, a fourth flower is found in the centre of the inflorescence, but without any bract attached to it (Fig. 4).



FIGS. 1–9. Fig. 1. A normal inflorescence. Figs. 2–3. Flowers with additional bracts; *a*, additional bract. Fig. 4. A four-flowered inflorescence. Figs. 5–9. Successive stages in the fasciation of two adjoining bracts resulting in the production of a biflowered cyme.

2. Usually there is one bract bearing one flower in its axil. But in certain inflorescences there are 1-2 additional under-developed bracts per flower (Figs. 2-3).

3. Two adjacent bracts of certain inflorescences have been found in all stages of fasciation (Figs. 5-9). In the first stage only the margins of two adjacent bracts one found partly fused, with distinct apices (Fig. 5). In the second stage the distinction of apices is lost, but that it is a fasciation product of two normal bracts is clear from its size, two mid-ribs, and two flowers borne on it (Fig. 6). In the third stage the midribs have also fused and the area of the fused bracts is further reduced. The two flowers borne on this bract (Fig. 7) indicate that it is a homologue of two normal bracts. In the fourth stage (Fig. 8) the "fused bracts" no longer bear two flowers, but it is still bigger than the other one. In the last stage the inflorescence is a biflowered cyme, hardly

retaining any sign of fusion of adjoining bracts (Fig. 9).

From the appearance of additional bracts per flower (Figs. 2-3) the question arises whether they are due to reappearance of phylogenetically lost parts, or they are new structures representing a forward trend towards multiplication in the number of bracts. In the light of the fact that in *Bougainvillea* practically no seeds are produced and that the sexual reproduction has been replaced by the vegetative, it is difficult to justify the idea of amplification in the floral parts. Thus it seems that these under-developed bracts are due to the reappearance of an ancestral feature; subsequently lost in the evolution of the inflorescence. That lost organs can sometimes reappear under conditions of cultivation is also known for the stamens of the 'female' flowers of *Ricinus communis* (Jain[5]).

The fasciation of adjoining bracts resulting in reduction in the number of bracts and flowers per inflorescence is definitely a forward trend, quite consistent with the replacement of sexual reproduction by vegetative reproduction both functionally as well as structurally.

My sincere thanks are due to Dr. R. N. Lakhanpal for very kindly going through the manuscript and offering valuable suggestions.

Birbal Sahni Institute of Palæobotany, Lucknow.
August 6, 1958.

R. K. JAIN.

1. Singh, T. C. N. and Sinha, B. N., *J. Indian bot. Soc.*, 1928, **17**, 99.
2. Singh, T. C. N., *Ibid.*, 1930, **9**, 248.
3. Joshi, A. C. and Rao, V. S., *Ibid.*, 1934, **13**, 169.
4. Marigowda, M. H., *J. Bombay Nat. Hist. Soc.*, 1957, **54**, 801.
5. Jain, R. K., "Studies in the floral morphology of 'bisexual' flowers of *Ricinus communis* L.," *MS.*

SOME OBSERVATIONS ON CONJUGATION IN *SIROCLADIUM KUMAOENSE* RANDHAWA

Sirocladium, a monotypic genus, was established by Randhawa[1] in 1941 from his algal collections of Almora District. The writer first came across this alga at Bhowali (Nainital District) in October 1956, and was subsequently found growing luxuriantly at several places in the vicinity of Nainital. It grows on damp soil in the form of dark-green patches and resembles certain terrestrial species of *Vaucheria* in external appearance. The alga was collected periodically during September-November 1957, and was always examined in the living condition.

The present alga closely resembles *Sirocladium kumaœnse* in the morphology of the vegetative cells excepting slight variations in their cell measurements. Sexual reproduction, like *Sirocladium kumaœnse*, occurs predominantly by scalariform conjugation between two geniculate gametangia. Besides this, in some cases certain cells of one of the two conjugating filaments may also be found conjugating in a ladder-like fashion (Figs. 1, 2). In such cases

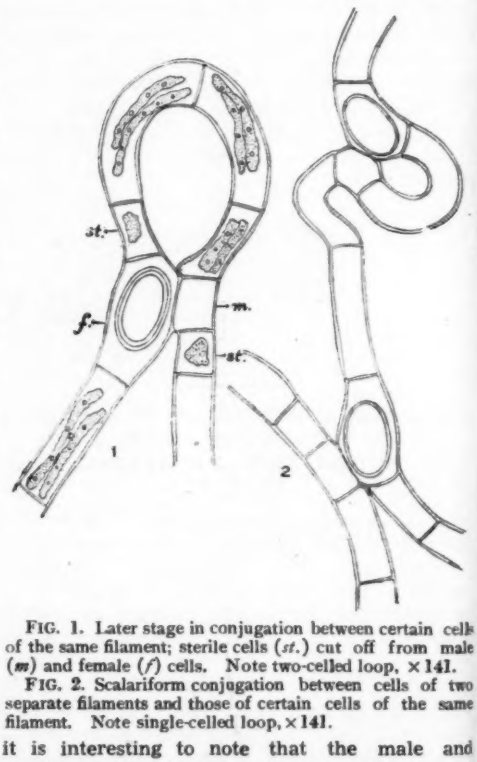


FIG. 1. Later stage in conjugation between certain cells of the same filament; sterile cells (*st.*) cut off from male (*m*) and female (*f*) cells. Note two-celled loop, × 141.

FIG. 2. Scalariform conjugation between cells of two separate filaments and those of certain cells of the same filament. Note single-celled loop, × 141.

it is interesting to note that the male and female gametangia conjugate after coiling round of the filament in the form of a loop (Figs. 1, 2). The loop may consist of one (Fig. 2) or several (Fig. 1) cells. The male and female gametangia in such cases are organized either by an unequal division of a vegetative cell (Fig. 1) or from a short undivided vegetative cell (Fig. 2). The zygospores formed in this case are ellipsoidal (Figs. 1, 2) and somewhat yellowish-brown in colour.

The present form has tentatively been identified as *Sirocladium kumaœnse* Randhawa.

The Nainital form, however, is of a special interest as it exhibits sexual conjugation between certain cells of the same filament, a phenomenon unrecorded so far in this genus.

Dept. of Botany, K. P. SINGH.
"Th." D.S.B. Govt. College,
Nainital, U.P., *July* 29, 1958.

1. Randhawa, M. S., "*Sirocladium*, a new terrestrial member of the Zygnemales," *Bot. Gaz.*, 1941, **103** (1), 192–97.

A SIMPLE PROBE ELECTRODE FOR COMPARATIVE STUDY OF CURRENT DISTRIBUTION AT SURFACES

DURING our studies of electropolishing systems in a Hull cell,[1-3] which give rise to bands of different reflectivity and polish on different parts of the same inclined anode, we found that such sharp contrasts and discontinuities between bands could not be explained on the basis of potential variation, measured with a Luggin capillary, along the surface of the electrode.[4] This clearly brought out the importance of studying actual current distribution, which may vary greatly due to edge-effects and differences in thickness, nature, etc., of surface layers at polarized electrodes. A reference to the literature did not reveal any simple and ready method of studying the current distribution at different points on a given electrode during polarization. After some initial trials, a method has now been evolved and a probe electrode designed as follows :

A square cross-section (1/8" square) perspex rod of about 6" length is taken and its edges slightly rounded and smoothed. On one end of it a small hole (about 1/40" dia.) is drilled and on two opposite sides of the hole circular single loops of two wires, of the same metal as under study, or preferably any other metal forming reversible electrode system, are fitted and their ends are taken out along opposite facets of the rod (See Fig. 1). The wire leads are secured to the sides of the perspex rod with joining cement, *e.g.*, "durofix' or quickfix' and then the whole assembly, excluding the hole and the wire loops across it, is well coated with an inert stopping off lacquer. This could be used as a probe electrode. When placed adjacent to the various parts of the electrode surface as shown in Fig. 1, by connecting the two wire leads to a sensitive low impedance galvanometer, the lines of force passing through that area converge to the wire loops and the galvanometer reading gives a comparison of the current densities in various regions of the

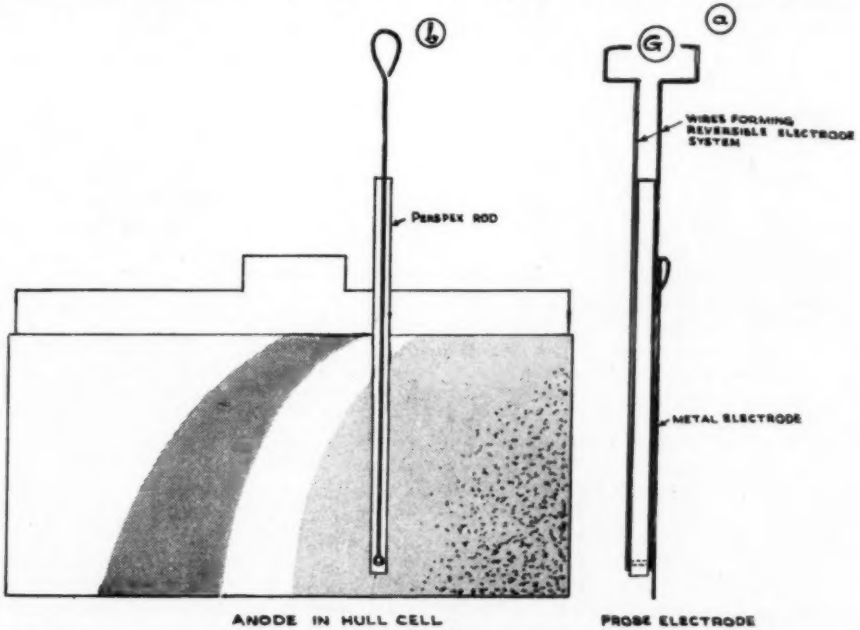


FIG. 1

electrode. Although, a correlation of the observed measurements with the absolute current densities at various points is difficult and depends among other things on the thickness of wire, area of loops, their positioning and the distance between them, a comparison can easily be made and relative variation of current density plotted against distance from one end. This method has been successfully used by us in our Hull cell studies and has been found to be quite useful in explaining the banded structure produced in polishing of copper.[5]

Sincere thanks are due to Dr. K. S. G. Doss, Director, Central Electrochemical Research Institute, for many helpful suggestions and discussions.

Central Electrochemical Research Institute, Karaikudi, India.
August 29, 1958.

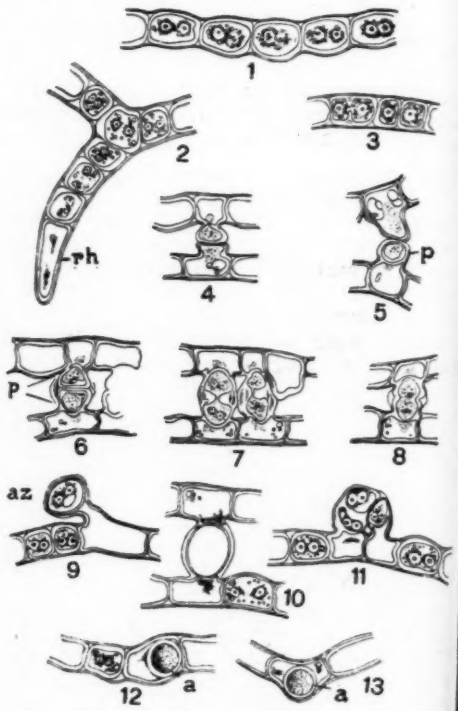
INDRA SANGHI.
VR. RAMANATHAN.

1. Hull, R. O., *Proc. American Electroplaters Soc.*, 27th Convention.
2. Cuthbertson, J. W., *Metal Industry*, Aug. 1951, 87.
3. Lorking, K. F., *J. Electrochem. Soc.*, 1955, **102**, 479.
4. Indra Sanghi and Ramanathan, VR., "Electropolishing of copper in orthophosphoric acid bath using a Hull cell under publication in the *Bulletin of the India Section of Electrochemical Society.*
5. — and —, "Some polishing experiments on copper in a Hyperbolic cell," *Proc. Ind. Acad. Sci.*, 1958, **48**, 284.

REPRODUCTION IN *ZYGOGONIUM ERICETORUM* KUTZ.

THE object of this note is to record two collections of *Zygogonium ericetorum* Kutz. from India and to describe its reproduction. A sample of this alga was collected by Dr. Aiyappa growing on laterite soil on hill slopes and open ground at Makoot (altitude 4,500') in Coorg, Western Ghats, in Mysore State. Another sample of this material, mostly infertile, was collected by me from Nandi Hills, Mysore State, growing in the form of pale-yellow and whitish felt-like patches on the footpaths. The material from Coorg showed conjugation apart from akinete formation. Both the collections were made in the middle of August 1958.

The filaments are simple with one- to many-celled rhizoids (Fig. 2). The vegetative cells are cylindrical, 15·2 to 26·6 μ, broad and 15·2 to 67 (— 100) μ long. The cell-wall is thick and colourless, and the chloroplasts are two rounded bodies with a single pyrenoid in each. The cell sap is colourless. The cells are loaded with food material. Most of the cells were in akinete condition. In some cases, the akinetes appear barrel-shaped with thick walls (Fig. 1). In some cases, the cells divide into two by ingrowth of septa from the side-walls, and akinetes with a single chloroplast are formed as in *Zygnema ternestre* Randh. (Fig. 3).



FIGS. 1–13. Fig. 1. Barrel-shaped akinetes in a filament. Fig. 2. A filament showing a multicellular rhizoid. Fig. 3. A filament with akinetes with a single chloroplast. Figs. 4–8. Stages in conjugation. Figs. 9 & 11. Azygospores. Fig. 10. A ripe zygospore. Figs. 12 & 13. Aplanospores. *a*, aplanospore, *az*, azygospore, *p* progamete (× 720).

Conjugation.—The process of conjugation is very similar to that described by De Bary and Hodgetts. Progametes are formed from a portion of the protoplast. The progametes are cut off from the gametangia by ingrowth of cell-wall, leaving remnants of protoplasm in the gametangia (Figs. 4, 5 and 6). A pore is formed between the progametes and it enlarges resulting in the fusion of gametes and formation of a zygospore (Figs. 7 and 8). Zygospores are ovoid, 15·2-26·6 μ broad and 26·6-30·4 μ long

In this specimen all the distinctive features of conjugation in *Zygogonium ericetorum* are seen, *e.g.*, formation of gametes only from a part of the protoplast, the remains of the protoplast in the gametangia, formation of walls which cut off gametes from the gametangia, and the peculiar method of fusion of the ends of papillæ.

Sometimes failure of conjugation takes place and azygospores are found at the tips of the conjugation tube attached to the gametangium (Fig. 9). Aplanospores which are rounded bodies, 15·2-22·8 μ in diameter, are also formed in the cells and cytoplasmic residue is clearly seen in the cell lumen outside the spore (Figs. 12 and 13).

This is the first record of *Zygogonium ericetorum* Kutz. from India and the mode of conjugation as described by Hodgetts in this species is also confirmed. Akinete formation of a new type is described.

Indian Council of Agricultural Research, Queen Victoria Road, New Delhi, *October* 11, 1958.

M. S. RANDHAWA.

1. De Bary, A., *Untersuchungen Über die Familie der Conjugaten*, Leipzig, 1858.
2. Hodgetts, W. J., *New Phyt.*, 1918, **17**, 338–51.
3. Iyengar, M. O. P., *Rev. Algol.*, 1932, **6**, 263–74.
4. Transeau, E. N., The *Zygnemataceæ*, Ohio State Univ. Press, Columbus, 1951.

THE UTILIZATION OF STARCH BY TWO SPECIES OF *PHYLLOSTICTA*

STARCH is the reserve carbohydrate in plants. Nearly all starches are composed of a mixture of two different kinds of polysaccharides, *viz.*, amylose and amylopectins, both of which give D-glucose on complete hydrolysis. Generally the parasitic fungi convert starch of the host cell into glucose before utilization. This conversion is caused by *amylases* which cause splitting of the glycosidic bond in the polysaccharide unit.

Four types of changes are brought about in the culture medium during the disintegration of starch : (1) a decrease in the viscosity denoting cleavage in the polysaccharide chain, (2) loss in the capacity to give blue colour with iodine, (3) appearance of reducing groups, (4) formation of maltose, glucose and additional oligosaccharides of varying chain-length.

Single spore cultures of *Phyllosticta cycadina* (Pass) and *P. artocarpina* (Syed *et* Butl), were inoculated daily in a culture medium (which contained 10 g. of starch, 3·5 g. of KNO_3, 1·75 g. of KH_2PO_4, 0·75 g. of $MgSO_4 7H_2O$, and distilled water 1 litre). The filtrate of each day was analysed chromatographically by the method described by Giri (1952). *n*-Butyl-alcohol-acetic acid and water (4 : 1 : 5) was used as developing solvent, while aniline diphenyl amine phosphoric acid (5 vols. of 4% aniline, 5 vols. of 4% diphenyl amine and 1 vol. of phosphoric acid) served as spray reagent.

The results showed that during the growth of these organisms, the starch was not only converted into maltose R_f 0·55 and glucose R_f 0·68 (the normal hydrolytic products of starch), but three other oligosaccharides (R_f 0·45, 0·37 and 0·3 respectively) also appeared in the culture medium (*vide* Fig. 1, bands III, IV and V respectively).

FIG. 1. Chromatogram showing the formation of glucose (Band I), maltose (Band II) and 3 oligosaccharides (Bands III, IV and V) during the growth of *P. cycadina* in the culture medium containing starch.

Hopkins (1946) classified the *amylases* into two broad groups, *viz*, α and β *amylases*. According to Hopkins the β *amylsaes* rapidly hydrolyse the amylose fraction of starch to maltose. This conversion is practically quantitative and only negligible amounts of oligosaccharides are formed. In contrast to β *amylases* the α *amylases* cause a rapid loss in the capacity of amylose to give blue colour with iodine and the rate of appearance of maltose is very slow. This indicates that in the present case the α *amylases* attack the interior chain of the glycosidic linkage and induce the formation of oligosaccharides.

The chromatograms clearly established that maltose was produced slowly in the culture medium. The results also established the formation of three synthetic oligosaccharides. Iodine test revealed that the growth of *P. cycadina* and *P. artocarpina* caused the disappearance of the starch of the culture medium on 3rd and 4th day respectively. These results further establish that these two species of *Phyllosticta* hydrolyse starch by *α amylases*.

Detailed investigations are in progress and the results will be published elsewhere.

The junior author is indebted to the authorities of National Institute of Sciences of India, for the award of a Research Fellowship.

Department of Botany, University of Allahabad. *August* 14, 1958.

R. N. TANDON.
K. S. BILGRAMI.

1. Giri, K. V., *Jour. Indian Inst. Sci.*, 1952, **34** (2), 95
2. Hopkins, R. H., *Advances in Enzymol*, 1946, **6**, 389.

COLOBODES DOLICHOTIS MARSHALL AS A PEST OF COWPEA

COWPEA (*Vigna catjang*) is an important pulse crop grown in South India. The writer, in the course of his studies on insects affecting this crop at Coimbatore, observed a good number of these plants grown at the Central Farm attached to Agricultural College and Research Institute, Coimbatore, wilting and drying. On examination, the stems of these plants were found badly riddled by the grubs of the weevil *Colobodes dolichotis* Marshall, and all stages of the weevil were noted inside the stem (Figs. 1 and 2). This weevil is a serious pest of *Dolichos lablab*, a common vegetable grown in kitchen gardens, in which case the grub riddles the stem and causes the formation of huge galls at the seat of injury. It has also been recorded on Redgram *Cajanus cajan* causing the same kind of injury at Coimbatore. The adult is a stout robust, dark brown beetle with a characteristic small V-shaped whitish mark on elytra, and measures about 8 mm. in length. The larva is a stout, fleshy white legless grub measuring 9 mm. in length, which riddles the tissues of the main stem and makes irregular galleries leaving plenty of frass behind as it bores onwards. Pupation takes place inside the stem and the pupa is white with prominent setigerous tubercles all over the body and measures about 8·2 mm. in length. The adult emerges by biting a hole at the sides. This is the first record of this weevil on this crop.

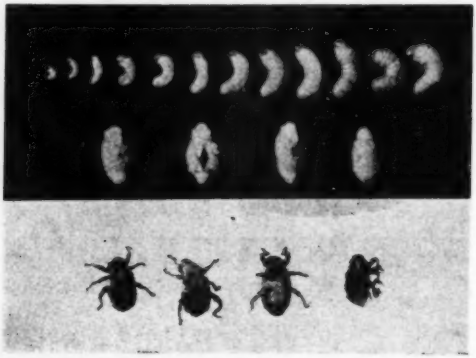


FIG. 1. Stages of *Colobodes dolichotis* M.

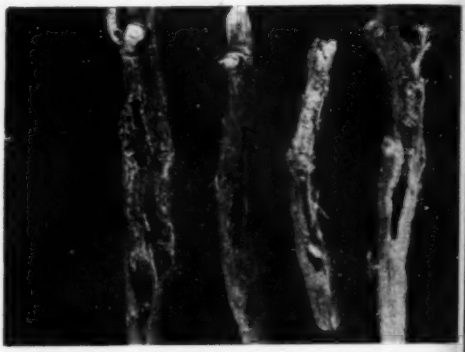


FIG. 2. Cowpea stem showing the damage by *C. dolichotis* M.

Entomology Section, Agricultural College and Research Institute. Lawley Road P.O., Coimbatore, *August* 12, 1958.

T. R. SUBRAMANIAN.

STRUCTURAL HYBRIDITY IN *ALLIUM OCHROLEUCUM*

Two bulbs of this species were received from Jardin Botanique, Mairie De Nantes, France, under the name *A. ericetorum* Thore. According to the Index Kewensis, the valid name of the species is *A. ochroleucum* Waldst. and Kit. The latter name has, therefore, been followed here. These bulbs were planted in pots and flowered last spring.

Nineteen chromosomes have been persistently counted in the root-tip cells (Fig. 1). Thirteen of these are metacentric (M), while the remaining 6 are telocentric (T). At metaphase the

centrameres of the telocentrics may be very minute and knob-like when undivided, or like horns of a snail when divided (*cf.* Marks[1]). No specific nucleolar constrictions could be made out.

Due to paucity of the material, the course of meiosis has not been followed in detail. However, metaphase-I is characterized by the presence of rings (Figs. 2, 3) and straight and zig-zag chains. These associations involve both metacentrics and telocentrics. The maximum number of chromosomes seen in an association is 6 which contained 4M – 2T (Fig. 3). The association of four chromosomes may contain 4M (Fig. 2), 3M – T or 3T – M (Fig. 2). The tripartite associations may be composed of 3 M, 2 M – T (Fig. 2), M – 2 T or 3 T. The bivalents may be composed of 2 M or 2 T (Figs. 2, 3) or M – T (Fig. 3). In the last case the bivalents are heteromorphic. At metaphase-I, the chiasmata are in general terminal, but in some cases the chiasmata may be interstitial. Darlington[2-3] has observed similar interstitial chiasmata in *Tradescantia* and *Oenothera*. According to him "the presence of a small non-homologous segment might offer a check to terminalization".

Anaphase-I was characterized by bridge-fragment configurations and at telophase-1, 0-3 micronuclei were found. Evidently, the present material is also heterozygous for inversions.

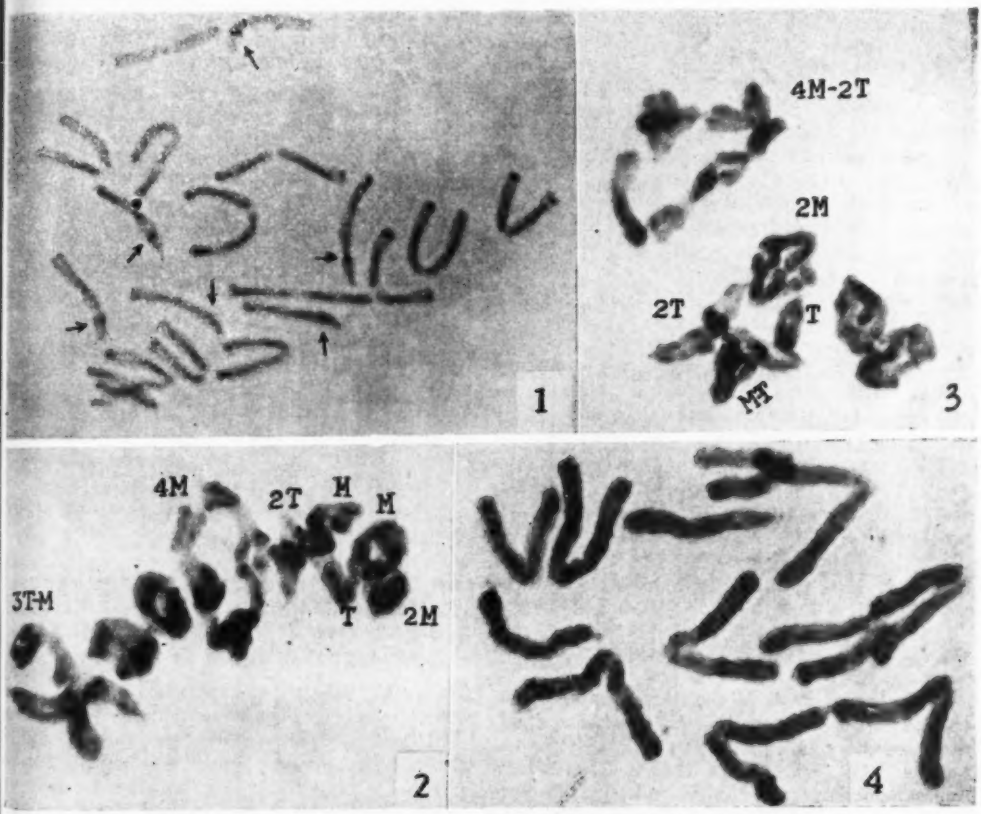


FIG. 1. Root-tip mitosis, $2n = 19$ (13M + 6T). Pretreated with 0·002 Mol. Soln. of 8 – 0 q, × 1,996.

FIG. 2. Metaphase-I with 3 T – M + 2 M + 2 M + 4 M + 2 T + 2 M – T + 2 M, × 781.

FIG. 3. Metaphase-I with 4 M – 2 T + 2 M + 2 T + M – T + T + 2 M + 2 M. One association of 2 M's is not in the field, × 781.

FIG. 4. One pole at anaphase-II with 12 chromosomes (10 M + 2 T), × 1,562.

Nine different anaphase-II poles were exceptionally clear. Their analysis is given in Table I.

TABLE I

Chromosome Number	Karyotype	No. of Poles
19	16 M+3 T	1
18	16 M+2 T	1
12	10 M+2 T (Fig. 4)	1
10	8 M+4 T	2
	7 M+3 T	1
	6 M+4 T	1
9	7 M+2 T	1
	6 M+3 T	1

It looks probable that the poles with 18 or 19 chromosomes were the result of highly unequal segregation at anaphase-I, followed by failure of anaphase-II. Alternatively, these may be the products of stray tetraploid pollen-mother cells. The above table shows that the sexual progeny of this taxon is expected to be extremely heterogeneous karyotypically.

On analogy with an allied genus *Nothoscordum* (*N. fragrans*. Levan and Emsweller,[4] Kurita[5]), it appears that the asymmetrical karyotype (13 M + 6 T) of the present species has evolved from a perfectly symmetrical one, containing 16 metacentric chromosomes. The mechanism of evolution may be misdivision, resulting in the fragmentation of metacentric chromosomes across the centromere. In *Allium* somewhat comparable situation is found in *A. condensatum* (Sato[6]). This species has $2n = 17$ (15 M + 2 T) and Sato advocates that out of the 16 original metacentric chromosomes, one has fragmented into 2 T. Same is also true of the karyotypes like $2n = 18$ (14 M + 4 T) found by Levan[7] in *A. pendulinum* and *zebdanense*.

With the present data on metaphase-I associations, it is not possible to conclude, if one chromosome each out of three different homologous pairs have fragmented, or if one complete homologous pair *plus* only one chromosome out of another homologous pair, have been involved in fragmentation.

The occurrence of rings and chains containing more than two chromosomes indicates clearly that extensive segmental interchanges have taken place. These have involved both metacentrics and telocentrics. Previously, besides *N. fragrans*,[4] segmental interchanges have also been observed in two species of *Allium* namely, *A. ammophilum*[7] and *A. scordoprasum* var. *viviparum*.[8]

This taxon is, therefore, a structural heterozygote and fragmentation, segmental interchanges and inversions have been responsible for its evolution. It may be pointed out that these changes only result in a reorientation of the genic material, altering significantly both the original karyotype and the homology of the chromosomes.

The writers have harvested apparently well-filled seeds. These contain embryos within; however, their viability and cytology are being studied. The mechanism of seed formation is also under investigation. More important method, by which the taxon seems to have been preserved, is the efficient vegetative reproduction.

We are deeply grateful to Prof. P. N. Mehra for his helpful suggestions, to Mr. R. S. Pathania for the photomicrographs and to Dr. P. Plantiveau for sending the bulbs.

Botany Dept., Panjab University, Amritsar, *August* 18, 1958.

T. N. KHOSHOO.
V. B. SHARMA.

1. Marks, G. E., *Chromosoma*, 1957, **8**, 650.
2. Darlington, C. D., *Jour. Genet.*, 1929, **21**, 207.
3. —, *Ibid.*, 1931, **24**, 405.
4. Levan, A. and Emsweller, S. L., *Jour. Hered.*, 1938, **29**, 291.
5. Kurita, M., *Mem. Ehime Univ., Sect. II (Sci.)*, 1953, **1**, 55.
6. Sato, D., *Jap. Jour. Bot.*, 1942, **12**, 57.
7. Levan, A., *Hereditas*, 1935, **20**, 289.
8. Katayama, Y., *Jour. Coll. Agr., Tokyo*, 1936, **13**, 431

AN IMPROVED METHOD OF TESTING THE LONGEVITY OF SPORES OF *TOLYPOSPORIUM PENICILLARIAE* BREF. IN SOIL

ABOUT ¼ square inch area on several clean slides was first smeared with juice from leaves of *Tradescantia tricolor* Hort.,[1] and dusted with smut spores collected during 1955-56, 1956-57 and 1957-58 (kept in the laboratory). After spores got fixed, several slides for each of the three years' samples were buried in November 1957 at 3, 6 and 9″ depth. One slide from each treatment was taken out regularly at monthly intervals. The slides were gently washed with sterile distilled water to remove soil particles and allowed to dry. A drop of sterile distilled water was then placed on spores and incubated under moist condition for 48 hours at 24-28° C. and germination recorded.

The results obtained showed that irrespective of the year of collection, the germination of spores buried at 6″ and 9″ depth was excellent

until August 1958 (further tests are under progress), while that of spores buried at 3" depth was excellent only up to March 1958; (declining thereafter). It may be that high temperature after March in the upper 3" layer of soil is not favourable for spores.

The method described here for testing the longevity of spores in soil has distinct advantages, in that :—

(1) the spores are in direct contact with soil in the most natural conditions, (2) the method avoids complicated procedure and (3) testing of germination is simplified.

Detailed investigations are in progress and will be reported elsewhere.

M. H. Patel.
M. J. Thirumalachar.
M. V. Desai.
M. K. Patel.

Dept. of Plant Pathology,
Institute of Agriculture,
Anand, *August* 2, 1958.

1. Thirumalachar, M. J. and Narasimhan, M. J., *Mycologia*, 1953, **45**, 461–68.

WILD RAMIE *BOEHMERIA PLATYPHYLLA* D.B. FROM WESTERN GHATS—A POSSIBLE SOURCE OF TEXTILE BAST FIBRE

Bœhmeria platyphylla D.B. is a highly variable polymorphic species widely distributed in Western India, Africa and Pacific Islands.[1,2] In view of its close taxonomic affinities with *B. nivea* cultivated for the industrial ramie fibre in Assam, China and Japan, *B. platyphylla* is being investigated in this laboratory. This species has not received attention so far as a fibre source though a few other related species have been tried.[3–4]

From the polymorphic mixture of this species growing wild along western slopes near Mahabaleshwar (3,500 feet), stems, four to five feet long and about half to one inch girth, were dried and decorticated in raspador yielding about 10% crude fibre. It consists of fibre aggregates held together by pigmented resinous coat along with pieces of pith. The crude fibre was degummed by repeated boiling in 1% sodium hydroxide, bleached with sodium sulphite, neutralised with acid and repeatedly rinsed in water. Alternate biochemical methods are under trial. Yield of bleached fibre is about 5% on air dry stems.

Fibres are white lustrous with smooth silky feel. Individual fibres are fine, strong, 9 to 36 microns in diameter and consist of either flat twisted ribbons or hollow medulated tubes with nodal swellings, lateral projections, tapering ends and smooth or rough topography (*see* photomicrographs). Fibre length is highly variable due to mechanical conditions in raspador and therefore not mentioned for the present.

A small sample was sent to the Jute Technological Research Laboratory, Calcutta, and the following values given in Table 1 for *B. nivea* and *B. platyphylla* fibres have been communicated.

It is thus seen from the technological report of the above laboratory, that the fibres of *B. platyphylla* are inferior to those of *B. nivea*. However, these values relate to a specific sample derived from a mixture of botanical forms. In view of the botanical diversity in the polymorphic *B. platyphylla*, isolation of superior

FIG. 1

FIG. 2

TABLE I

Character	Mean Value	
	B. nivea	*B. Platyphylla*
1 Gravimetric measure (Mass per unit length)	$8 \cdot 49 \times 10^{-6}$ gm./cm.	$3 \cdot 77 \times 10^{-6}$ gm./cm.
2 Elliptical cross-section (on 150 filaments)	$7 \cdot 038 \times 10^{-11}$ sq. cm.	$4 \cdot 186 \times 10^{-6}$ sq. cm.
3 Flexural elastic modulus	..	$11 \cdot 7 \times 10^{11}$ dynes/cm.^{2}
4 Breaking stress	$74 \cdot 7 \times 10^8$ dynes/cm.^{2} (approximately 65±5% R. H.)	$31 \cdot 8 \times 10^8$ dynes/cm.^{2}

fibre types should be possible, with quality attributes approaching those of industrial ramie. A few such botanical types have been already isolated and are individually studied for their fibre properties.

A large number of seedlings as well as sets of *B. nivea* were planted at Mahabaleshwar during June and October 1952 but the plants from both these plantings perished during the following summer when subsoil moisture in porous laterite soils becomes scanty. Under the same conditions, however, *B. platyphylla* grows as a perennial and survives through summer dormancy. It can thus be cultivated as a purely rainfed perennial crop without any irrigation, on poor eroded hill slopes along contour ridges, giving one or two harvests of their stems during the monsoon and winter each year. It is intended to formulate suitable cultivation methods and work out the economic aspects.

Authors are deeply indebted to Dr. K. R. Sen of the Jute Technological Laboratory for his kind co-operation in fibre testing. Thanks are due to Prof. S. P. Agharkar for his keen interest and valuable discussion and to Shri S. G. Shende for certain facilities.

G. B. DEODIKAR.
S. D. PATWARDHAN.
M.A.C.S. Biological Laboratories,
Law College Buildings,
Poona-4,
July 28, 1958.

1. Cooke, Th., *The Flora of the Presidency of Bombay*, 1907, **2**, 636.
2. Hooker, J. D., *The Flora of British India*, 1890, **5**, 579.
3. Watts, G., *A Dictionary of the Economic Products of India*, 1889, **1**, 483.
4. C.S.I.R., *The Wealth of India—A Dictionary of Indian Raw Meterials and Industrial Products*, 1948, **1**, 198.

EFFECTS OF SULPHANILAMIDE ON AN EARLY VARIETY OF RICE

AFTER the report of the effectiveness of sulphanilamide as a bacteriostatic agent,[6] its effects have been studied on moulds (*Aspergillus* sp.),[2] yeasts,[3] roots of *Lepidium sativum*,[1] *Pisum sativum*[5,7] and *Lupinus* sp.,[5] seeds,[3] seedlings[4] and cuttings of higher plants.[3] In the present investigation an attempt has been made to study the effects of sulphanilamide on the growth and flowering behaviour of an early variety of rice, N. 136.

In Series I the treatment consisted of soaking the seeds for 48 hours in the aqueous solution of sulphanilamide at different concentrations of 1, 10, 100, 1000 parts per million (p.p.m.). In Series II in addition to this soaking treatment, plants were sprayed with the corresponding solution once a week starting with 3-week-old seedlings till panicle emergence. Controls were soaked in water.

Higher concentrations of 100 and 1000 p.p.m. of sulphanilamide bring about a delay in ear-emergence in both the series, more predominantly in Series II, while the lowest concentration of 1 p.p.m. brings about slight earliness. No change in flowering behaviour is seen with 10 p.p.m. (Table I).

TABLE I

Time from sowing to ear-emergence of the main shoot in days

(Average of 16 plants. Sowing date—January 11, 1958.)

Treatments	Days from sowing to ear-emergence			Earliness (+) or delay (−) in days from control
	Seed soaking (Series I)	Seed soaking *plus* spray (Series II)	Mean per treatment	
1 p.p.m. ..	70·00	70·00	70·00	+0·69
10 p.p.m. ..	70·19	72·19	71·19	−0·50
100 p.p.m. ..	71·94	74·06	73·00	−2·31
1000 p.p.m. ..	76·50	78·00	77·25	−6·56
Control ..	70·87	70·50	70·69	
Mean per series	71·90	72·95		

S.E. Mean for chemical effect		= 0·23 and
	C.D. at 5%	= 0·65
do.	soaked and soaked *plus* spray	= 0·14 and
	C.D. at 5%	= 0·41
do.	interaction	= 0·32 and
	C.D. at 5%	= 0·92

The production of tillers and leaves and the elongation of the shoot in general is stimulated

TABLE II

Effect of sulphanilamide on tillers, leaves and plant height

(Mean value of both the series. Average of 16 plants in each series)

Treatmen s	Number of tillers per plant 15-2-58	2-3-58	17-3-58	Total number of green leaves per plant 15-2-58	2-3-58	17-3-58	Height per plant in cm. 15-2-58	2-3-58	17-3-5
1 p.p.m.	2·03	3·97	3·75	6·78	17·09	12·75	25·66	46·60	60·50
10 p.p.m.	1·88	3·59	3·47	6·81	15·53	14·37	25·44	45·97	58·66
100 p.p.m.	1·56	3·63	3·66	5·59	15·16	13·69	23·47	44·56	57·98
1000 p.p.m.	1·00	3·00	3·16	3·44	11·59	11·28	18·50	39·48	52·21
Control	1·75	3·53	3·38	6·53	14·43	12·65	24·75	45·44	58·73
S.E. Mean ..	0·06	0·12	0·07	0·28	0·57	0·88	0·39	0·59	0·52
C.D. at 5% ..	0·18	0·35	0·21	0·79	1·63	2·54	1·13	1·71	1·50

in the plants treated with low concentrations of the drug whereas the highest concentration of 1000 p.p.m. produces significantly depressing effects in all these characters (Table II).

Thus the growth responses to sulphanilamide exhibit promotive effects at low concentrations and inhibitory effects at high concentrations.

Department of Botany, G. MISRA.
Ravenshaw College, D. MISHRA.
Cuttack-3,
August 4, 1958.

1. Audus, L. J. and Quastel, J. H., *Ann. Bot. N.S.*, 1948, **12,** 27.
2. Fourneau, F. *et al.*, *Comptes. Rend. Soc. Biol.*, 1936, **122,** 652.
3. Grace, N. H., *Canad. J. Res.* (*Sec. C*), 1938, **16,** 143.
4. Macht, D. I. and Kehoe, D. B., *Fed. Proc. Amer. Physio. Soc.*, 1943, **2,** 30.
5. Mangenot, G. and Carpentier, S., *Comptes. Rend. Soc. Biol.*, 1941, **135,** 1053.
6. Tréfouël, J. *et al.*, *Ibid.*, 1935, **120,** 782.
7. Wiedling, S., *Naturwissenschaften*, 1943, **30,** 114.

UTILIZATION OF WASTE MYCELIUM OF *PENICILLIUM CHRYSOGENUM* AS THE ONLY NITROGENOUS RAW MATERIAL IN PENICILLIN FERMENTATION

IN a large penicillin factory a few tons of waste mycelium of *P. chrysogenum* are filtered off every day at the end of penicillin fermentation. The disposal of this waste product is an industrial problem. Proximate analysis of the mold waste obtained in this factory has shown a crude protein content of about 44% on a dry basis.[1]

A vegetative inoculum of *P. chrysogenum* has been found to grow very well and produce penicillin at the normal rate in a standard medium for penicillin fermentation in which the two usual nitrogenous raw materials, *viz.*, cornsteep liquor and pea-nut meal are completely replaced by suitable quantity of waste mycelia.

The mycelial mass has been observed to serve well as the sole source of nitrogen without any treatment whatsoever except the usual sterilization along with other constituents of fermentation media.

Typical experiments carried out in shake flasks and 500 gal. stirred and aerated fermentor are presented in Tables I and II. The normal-

TABLE I

Shake flask fermentations

Hours of fermentation	Control (normal media) Penicillin μ/ml.	pH	Experimental (with mycelium) Penicillin μ/ml.	pH
72	1330	6·20	1290	6·20
96	2280	6·85	1970	6·50
120	2950	7·95	2800	7·10
144	2440	8·2	3040	7·5
168	Autolysis	..	3064	..
186	..	..	3000	8·05

TABLE II

Stirred and aerated fermentor (500 *gal.*) (*with mycelium*)

Hours of fermentation	Penicillin μ/ml.	pH
41	900	6·8
49	1300	6·9
65	1900	6·9
89	2150	7·0
97	2350	7·0
120	2600	7·0

fermentation medium contained lactose, corn-steep liquor, pea-nut meal and salts. In the medium containing mycelia, 20 parts of wet mycelia (dry matter 15-20%) were used in place of cornsteep liquor and pea-nut meal. A vegetative inoculum of a commercial strain of *P. chrysogenum* was used. All shake flask fermentations were carried out in duplicate at 24° C. in 100 ml. volume of media in 500 ml. shake flasks on a rotary shaker with 250 r.p.m. describing a circle of about 2" diameter. Phenyl acetamide, 0·1% was used initially as precursor. Penicillin fermentation in 500 gal. fermentor was made under commercial conditions using 0·1% phenyl acetamide initially and adding 0·05% phenyl acetic acid at 72 hrs.

Penicillin was estimated by a modified iodometric method[2] and occasionally checked by standard bioassay. pH was determined by glass electrode.

Use of waste mycelia as one of the principal raw materials for penicillin fermentation is a highly attractive proposition for a penicillin factory. The above results are clearly indicative of such possibilities. Experiments are in progress to determine the optimum conditions of fermentation with waste mycelia. Details will be published elsewhere.

The author is grateful to the Production Department for active co-operation and to Mr. B. N. Ganguli for technical assistance.

Biochemistry Division, D. GHOSH.
Antibiotics Research Centre,
Hindustan Antibiotics (P.) Ltd.,
Pimpri-Poona,
August 8, 1958.

1. Deshpande V. N., Ganapathi, K., Damle, S. P., Vinze, V. L., Vartak, H. G., Phadke, N. S. and Ghosh, D., *Antibiotics, A Symposium*, Council of Scientific and Industrial Research, New Delhi, 1958, 110.
2. Alicino, J. F., *Ind. Eng. Chem. (Anal. ed.)*, 1956, **18**, 619.

ON THE OCCURRENCE OF THE METACERCARIAE OF *CLINOSTOMUM* SP. IN *TRICHOGASTER FASCIATUS*

THE matacercariæ of *Clinostomum* Leidy have been commonly found under the skin and in the muscles of fishes and tadpole larvæ of frogs. The adults usually occur in the buccal cavity and pharynx of fish-eating birds and reptiles.

These metacercariæ have been reported from a number of Indian freshwater fishes by Bhalerao (1942) and B. L. Kaw (1950). So far none has found them in *Trichogaster fasciatus* Bl. and Schn.

About 40 specimens of *Trichogaster fasciatus* obtained from various ponds in and around Patna were dissected and all of them were found to harbour this matacercaria. The average number of matacercariæ found in a single fish was 6. They were found in the peritoneal cavity and a few in the branchial cavity. Most of the metacercariæ were found adhering to the wall of the intestine by their well-developed ventral sucker. No encysted metacercaria was found in any fish. Attempts were made to find this matacercaria in other species of fishes inhabiting similar localities as *T. fasciatus*. Numerous specimens of about 25 species of fishes were dissected but none of these were found infected with this matacercaria.

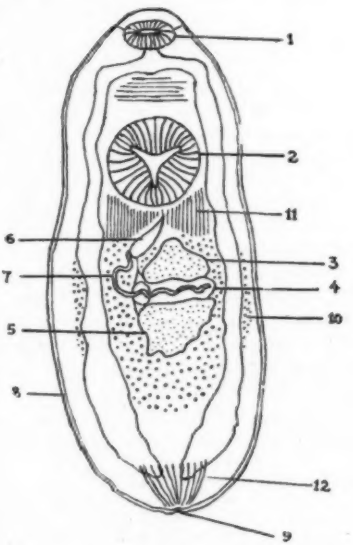
T. fasciatus, therefore, seems to be the normal intermediate fish host of the matacercaria of *Clinostomum*. This was confirmed by the universal occurrence of this parasite in *T. fasciatus* in Patna. In some of the fishes the infection was very heavy and in one specimen as many as 32 metacercariæ were found. The fish hosts were apparently unaffected by the presence of these matacercariæ.

Specimens of the matacercariæ were fixed in Bouin's and Semichon's solutions and were stained in Ehrlich's Hæmatoxylin. The metacercaria has a flat and elongated body with a well-developed ventral sucker placed somewhat close to the oral sucker. The body is narrower in front of the ventral sucker than behind it. A short œsophagus is present which divides into two long and smooth intestinal cæca which reach nearly to the posterior tip of the body. A pharynx was not observed in any specimen. A network of excretory vessels was clearly seen specially in specimens obtained from the hosts starved for about 15 to 20 days. This was probably due to a tendency of accumulation of excretory wastes in such specimens. The rudiments of the gonads were present in the anterior half of the region behind the oral sucker. The ovary lies between the two testes. The rudiments of the vitelline glands are seen along the lateral region of the middle of the body. Traces of spines are present in the cuticular layer of the body-wall. The excretory pore is situated at the posterior tip. Some of the measurements of the matacercaria are given below in mm. :—

Length of the body	2·025-4·850
Breadth of the body	0·754-1·545
Diameter of the ventral sucker	0·345-0·475

Transverse diameter of the oral sucker	.. 0·105-0·254
Longitudinal diameter of the oral sucker	.. 0·095-0·226

Attempts were also made to study the partially developed adult, after feeding the pigeons with the metacercariæ. In one attempt a pigeon was fed with 12 metacercariæ and after 72 hours of feeding 9 metacercariæ were recovered, of which 2 were inert. The metacercariæ were apparently digested by the pigeon when they remained in its body for more than 72 hours.



FIGS. 1–12: 1. Oral Sucker. 2. Ventral Sucker. 3. Anterior Testis. 4. Ovary. 5. Posterior Testis. 6. Cirrus Sac. 7. Uterus. 8. Cuticle. 9. Excretory Pore. 10. Vitelline Gland. 11. Part of Longitudinal Muscle. 12. Terminal part of Longitudinal Muscle.

Camera Lucida sketch of a metacercaria of *Clinostomum* sp. from *Trichogaster fasciatus*. (Stained with Ehrlich's Hæmatoxylin). Magnified approx. 50 times.

The partially developed adults were similar in disposition of the organs to the metacercariæ described above. The gonads, however, were more differentiated and showed a marked development. The testes were clearly seen consisting of two lobes placed anterior and posterior to the ovary. The cirrus and the cirrus-sac were seen anterior and to one side of the anterior testis. The ovary and the coil of the uterus were clearly seen. No ova were found in the uterus. The female opening and the terminal portion of the uterus were not clear. No other development was detected. The intestinal cæca were smooth and unbranched, with an accumulation of food in the posterior blind end which was somewhat distended.

The author is indebted to Dr. Suresh Keshava, Professor of Zoology, University of Patna, for suggestions and laboratory facilities, and feels grateful to Dr. M. B. Lal, Professor of Zoology, University of Lucknow, for identification of the metacercaria and suggestions.

Department of Zoology, S. N. AHSAN.
University of Patna, Patna 5,
August 10, 1958.

1. Bhalerao, G. D., *Proc. Ind. Acad. Sci.*, 1942, **16**.
2. Hunter, G. W. and Hunter, W. S., *Jour. Parasitol.*, 1935 *a* & *b*, **21** (3 and 4).
3. Kaw, B. L., *Ind. J. Helminthology*, 1950, **2**.
4. Nigrelli, R. F., *Zoologica, N. Y.*, 1936, **21** (4).

FEMORAL SPINES AS A PHASE CHARACTER IN THE DESERT LOCUST

THE sensitivity of the hind-femur length as a phase character in the Desert Locust, *Schistocerca gregaria* (Forskal), has been well established (Roonwal,[1] Roonwal and Nag,[2] and Misra, Nair and Roonwal[3]). Recently, Mukerji and Chatterjee[4] stated that the spines or denticles on the upper (dorsal) edge of the hind-femur in *Locusta migratoria* Linn. from Southern India probably vary with the phase. We have studied this latter character in detail in *Schistocerca gregaria* and have established it to be a phase character.

Two types of hind-femoral spines are distinguishable, *viz.*, (*i*) large, well-developed spines (height "A" or maximum straight-line height from tip to base, 0·037-0·111 mm.); and (*ii*) weakly developed spines (height "A", 0·009-0·055 mm.).

In individuals of the *solitaria* phase both types of spines, the well developed and the weak, are present in almost equal numbers. In the *gregaria* phase, on the other hand, only the weak spines are present. As regards the weak spines, while they show sexual differences within the same phase, there are generally little or no phase differences when comparisons are made within the same sex.

In the *solitaria* phase there are about 7-9 (mean 8) well developed spines and 6-11 (mean 8) weak spines, or a total of about 14-19 (mean 16) spines. No sexual difference is discernible in this respect. In the *gregaria* phase, where only weak spines are present, their number is about 18-22 (mean 20) in males and 17-21 (mean 18) in females.

The length of the spine-bearing area (a) was studied in relation to the total length of the hind-femur (b). In the *solitaria* males the ratio b/a is $0{\cdot}428 \pm 0{\cdot}006$ and this figure is significantly less than in females ($0{\cdot}469 \pm 0{\cdot}007$). In the *gregaria* phase, however, the ratio in males ($0{\cdot}486 \pm 0{\cdot}007$) is significantly higher than in females ($0{\cdot}453 \pm 0{\cdot}013$).

Sexual dimorphism in respect of the size, etc., of the spines was also studied. It was found that the size is larger in females than in males.

Fuller results will be published elsewhere.

Zoological Survey of India, Calcutta, *August* 12, 1958.

M. L. ROONWAL.
R. K. BHANOTAR.

1. Roonwal M. L., *Rec. Indian Mus.*, Delhi, 1949, **45** (2-3) (1947), 149–65.
2. — and Nag, M. K., *Ibid.*, 1951, **47** (3–4) (1949), 265–75.
3. Misra, S. D., Nair, K. R. and Roonwal, M. L., *Indian J. Ent.*, New Delhi, 1952, **15** (2), 95–152.
4. Mukerji, S. and Chatterjee, S. N., *Ibid.*, New Delhi, 1956, **18** (2), 161–64.

ANOTHER CASE OF INTERACTION OF FACTORS IN *CICER ARIETINUM* L.

CHOUDHARY (1957) described two tiny-seeded segregates in *Cicer* having small-sized leaves and tiny pods containing small seed. The tiny pod and seed were observed to be recessive to the normal pod and seed of the 'Chafa' variety (Kadam, 1945) and differed from it by a single pair of factors.

A similar *small-leaved* and tiny-seeded spontaneous mutant was spotted by the author (Argikar: unpublished) in a crop of 'Chafa' gram in 1948-49. In 1953-54, this new mutant was crossed with the *tiny-leaved* from (Ekbote, 1937; Choudhary and Argikar, 1957; Argikar, 1958), having tiny, clustered pinnules but normal-sized pods and seed. The seed, leaf and leaflet measurements of the two mutants used in the cross and of their F_1 hybrid are presented in Table I along with those of the normal type 'Chafa'. For the sake of convenience, the *tiny-leaved* form will be denoted as Mutant A and the small-leaved one as Mutant B in this note.

The F_1 hybrid of the cross between the two mutant forms had, therefore, *normal* leaves, leaflets and seed. The F_2 segregation observed for the leaf character is presented in Table II.

Since the fit for a digenic ratio is good, it is proposed to designate the Mutant A as Tlv Tlv smlv smlv and the Mutant B as tlv tlv Smlv Smlv.

The F_3 frequencies and the genic symbolization of the types obtained are given in Table III.

The F_3 study confirms the F_2 findings. It will be seen that both the dominant genes Tlv and Smlv interact to produce *normal* leaf while Tlv alone produces *small* leaf as found in Mutant B, Smlv causing the leaf to be *tiny* as in Mutant A. The double recessive also produces *tiny* leaves.

TABLE I

Name of the type	Mean size of the seed in mm.		Mean leaf length in mm.	Size of the leaflet in mm.		Mean 100 grain weight in mg.
	Length	Width		Length	Width	
Mutant A ..	7·8	5·7	32·5	5·0	1·5	11·79
Mutant B ..	5·6	3·9	35·0	6·5	4·0	4·20
F_1 hybrid ..	7·9	5·8	40·0	8·5	5·0	12·00
Chafa (normal) ..	8·0	5·9	45·0	8·5	5·0	13·50

TABLE II

Name of the cross	No. of plants having			Total	X_2	P value
	Normal leaves	Small leaves	Tiny leaves			
Mutant A × Mutant B ..	247	88	97	432	..	..
Reciprocal of the above ..	90	38	53	181	..	..
Total observed ..	337	126	150	613	..	..
Expected on a 9 : 3 : 4 ratio ..	344·80	114·94	153·26	613	1·59	0·20–0·30

TABLE III

F_2 Phenotype	Genotype	No. of F_3 progenies	F_3 frequencies	Ratio	X_2	P value
Normal-Leaved	Tlv Tlv Smlv Smlv	3	143 Normal-leaved plants	Breeding true	..	..
	Tlv Tlv Smlv smlv	8	272 Normal 178 Small-leaved	3 : 1 Fit not very good	..	..
	Tlv tlv Smlv Smlv	8	284 Normal 110 tiny-leaved	3 : 1	1·790	0·10-0·20
	Tlv tlv Smlv smlv	5	110 Normal 51 Small 53 tiny-leaved	9 : 3 : 4	4·070	0·10-0·20
Mutant B ..	Tlv Tlv smlv smlv	1	63 Small-leaved plants	Breeding true	..	..
	Tlv tlv smlv smlv	3	97 Small 33 tiny-leaved	3 : 1	0·033	0·95-0·90
Mutant A ..	tlv tlv Smlv Smlv tlv tlv Smlv smlv tlv tlv smlv smlv	10	213 tiny-leaved plants	Breeding true	..	..

Studies on the inheritance of the seed character in the above cross indicated that the normal seed was dominant to the tiny seed, the difference being monogenic. When the two characters, *viz.*, the leaf and seed types are considered together in all the plants that bore seed, it is found that one of the two dominant factors that affect the leaf is also responsible for the production of normal seed ; the same character in its recessive condition produces tiny seed. From the recombinations obtained for the leaf and seed characters as are presented in Table IV, it will be observed that the factor Smlv causes the seed to be of normal size while smlv governs the *tiny* size, the factor Tlv having no effect on the seed character.

TABLE IV

	Normal-leaved normal-seeded	Small-leaved tiny-seeded	Tiny-leaved normal-seeded	Tiny-leaved tiny-seeded	Total
Observed No.	310	102	97	32	541·00
Expected on a 9 : 3 : 3 : 1 ratio	304·40	101·40	101·40	33·80	541·00

X_2—0·18 ; P—between 0·95–0·99. The fit is good.

The *normal* leaf in *Cicer* could, therefore, be now designated as Slv Slv Tlv Tlv Nlv Nlv Glv Glv Alv Alv Smlv Smlv comprising of at least six pairs of factors in continuation of the five already mentioned (Argikar, 1958).

The author is grateful to Dr. R. D'Cruz for his kind help in scrutinising this note.

Bombay Agric. Dept., Poona, *September* 10, 1958. G. P. ARGIKAR.

1. Argikar, G. P., *Curr. Sci.*, 1958, **27**, 183–84.
2. Choudhary, B. B. and Argikar, G. P., *Ibid.*, 1957 **26**, 395.
3. —, *Ibid.*, 1956, **25**, 330–32.
4. Ekbote, R. B., *Ibid.*, 1937, **5**, 648–49.
5. Kadam, B. S., *Indian Farming*, 1945, **11–12**, 539–40.

ULTRASONIC WELDER

THE welding industry has a valuable new piece of equipment in a 2,000-watt welder, part of the *Sonoweld* line which utilizes ultrasonics to join similar and dissimilar metals without fusion, and with very little external deformation.

Ultrasonic welding is a solid state joining process in which the materials to be joined are subjected to high frequency alternating vibrations, which are generated by the transducer in the welding head system and transmitted through the coupling members to the work being done. The resulting joints are accomplished without fusion, and, in many materials, exceed the strength of similar joints made by standard resistance welding methods.—*J. Frank. Inst.*, October 1958.

REVIEWS

The Evolution of Development. By J. T. Bonner. (Cambridge University Press, Bentley House, 200, Euston Road, London, N.W. 1), 1958. Pp. 102. Price 17 *s.* 6 *d.*

Dr. Bonner's controversial lectures given at University College, London, less than two years ago have now been printed. They were controversial because they demanded imagination and humility. His critics were whisked from subjects about which they had never heard, and therefore had no previous interest, to those about which they were so convinced that "they knew it all before" that they switched off mentally, and so did not recognise that it was at least being said "inside out", and often in consequence, it was not only surprising but constructive.

For example, Dr. Bonner's main attack is one of the most well-tried in biology. He examines the efficient causes of an evolutionary advance by the method of comparing the many unsatisfactory attempts to solve it; as for example, an understanding of the function of the reptilian-avian egg may be sought in a comparison of the many kinds of terrestrial eggs of amphibia and fishes; and discussion of the "conquest of the land" requires an understanding of the stimuli that bring so many fish species up to gulp atmospheric air.

But Dr. Bonner applies this method to the very general problem of a repeated development of multicellularity from a unicellular zygote by each individual (*Sensu lato*) in every generation, and he can speak of the solutions not in this anthropomorphic, creationist, finalistic vocabulary which I have used, but as the result of past and continuing selection pressures. The nature of embryologist's material makes this especially difficult for them—witness their leanings towards Lysenkoism.

I think many young people may (perhaps) overestimate Dr. Bonner, because they will remember all their lives the excitement with which they read this book. It is especially recommended to Indian readers because it gives some glimpse of the *bhakti* which is inseparable from this sort of biological research in the West, and is so sadly rare in this country.

H. SPURWAY.

Biological Ultrastructure. By Arne Engstrom and J. B. Finean. (Academic Press, Inc., New York), 1958. Pp. ix + 326. Price $ 8.00.

The field of biological ultrastructure and the molecular organisation in living systems has attracted a great many workers from diverse fields like histology, biochemistry and X-Ray crystallography. The results of their researches have contributed to the vast growth of the subject in recent times. The aim of the book according to the authors is to provide an introductory account of the subject to students and research workers in a variety of areas ranging from zoology and botany, medicine and pathology to biochemistry and biophysics. In this aim the authors have achieved good success.

Nearly a third of the book form the prologue to the main theme, developed in the rest of the pages, and deals with the methods in ultrastructural research and the principles of molecular structure. The latter topic is bound to be particularly useful to those who are not very familiar with the principles of stereochemistry and the reactives of the various simple molecular groupings. Though it is not possible to give, in a book of this size, anything but a short account of any of the topics chosen, one still wishes that the chapter on experimental procedures were treated in greater detail.

The subject-matter of this book—molecular organisation in living systems—is treated under five chapters, *viz.*, the role of proteins, lipids, nucleic acids, carbohydrates and minerals. These contain much of recent work on the structural models of many macromolecules, their aggregations and their mutual interactions. Wherever it is possible to speculate, ideas are given about the mechanism governing the synthesis of these macromolecules in the living systems and the subsequent formation of the morphologically distinguishable components. Perhaps some of the ideas presented in this volume are likely to be modified in the wake of further researches. But, as it is, the book gives an excellent account of the present state of knowledge and the trend of further research in this field.

The book is very well written : the presentation is remarkably original and the style generally very lucid. There are few misprints and the get-up is excellent. The most attractive

feature of this book is, however, the abundance of illustrations and diagrams—all beautifully reduced. The book will prove to be an important and a very useful aid to all those interested in biological research.

Y. T. THATHACHARI.

Bioenergetics. By Albert Szent-Gyorgyi. (The Academic Press, Inc., New York), 1957. Pp. x + 143. Price $4.50.

This is a highly readable book written by one of world's greatest workers and thinkers in the field of biochemistry. It contains three almost equal parts: (1) General considerations, (2) Biological Structures and Functions, (3) On Drugs, Hormones and Diseases. The object of the book is stated as follows. One of the most characteristic features of present-day biochemistry is the co-existence of highlights with darkness, knowledge with ignorance. While we have an astounding knowledge about the processes in which our foods are used to build our body, we know nothing about how energy is driving life. The book represents an attempt to provide this knowledge.

In the beginning of the first part, the problem is stated clearly using the well-known subject of muscle contraction as example. The conclusion is reached that the energetics of the living world consist of only two processes: photosynthesis and its reversal. The energy stored up in the molecule by the former process is marked (E) and the excitational energy as E^*; the transformation is then represented as $(E) \rightarrow E^* \rightarrow W$. The author then develops the idea of the transmission of energy from one part of a molecule to another by means of free electrons. The phenomenon of fluorescence is used to indicate that the molecule is capable of accepting and transmitting energy and does not dissipate it. In this process water plays an important part as a regulatory influence. Its capacity is attributed to its strong dipole nature and its tendency build structure-ordered layers around surfaces reaching deep into the fluid phase. The water structures built around dissolved molecules will vary with the atomic groupings involved. The dimensions and the nature of the 'ice bergs' will decide how far these molecules can approach one another and interact. A further conclusion is that within the water structure electronic excitations may assume an unusual long-lived form suited for biological energy transmissions. Water and the electromagnetic field are thus considered to provide the matrix of life. In this line of thought the phenomenon of quenching and the part played by quenchers provide useful information regarding the mechanism of interference with excitation.

The ideas developed in Part I are applied in Part II to biological structures and functions. The explanation of molecular contraction is as follows: the myosin particle is kept stretched out by its water structures; contraction is induced by the collapse of these structures, the re-establishment of which is relaxation. The A.T.P. molecule is considered to be not only a storage battery, but also a transformer and it is able to perform its function because of the correct dispositions of the concerned oxygen and nitrogen atoms and for a similar reason riboflavin phosphate is efficient in oxidative phosphorylation. Then follows a discussion of the effect of ions, glutathione, sugars and alcohols, oxidative phosphorylation and uncoupling.

The final part dealing with Drugs, Hormones and Diseases starts with the declaration: "The author's research has always been dominated by the idea that there is but one living matter which has overgrown this globe's surface, taking on different shapes, sizes, colours and complexities, adapting itself to different conditions. In spite of the great variations in its appearance life is built on the same limited number of basic principles, wherever and in whatever form we meet it; there is no real difference between cabbages and kings. But if the foundations of normal life are simpler than its appearance, then the same may be true also for disease, and a great variety of symptoms can be caused by disturbance of single basic mechanisms, and the way in which disease declares itself may have no direct relation to the underlying cause". It is followed by an interesting discussion of a few typical drugs and of diseases, Myotonia, Myasthenia and Cancer.

The author concludes, "I have no doubts that the coming century will witness a profound revolution, extension of biology, the establishment of a quantum mechanical biochemistry, built on top of the Lucretian one. This book may be but one of the early swallows of this spring".

The book provides most fascinating reading and is fully thought-provoking. It is not a textbook for the uninitiated, but can provide the excitational energy for scientific adventure.

T. R. S.

The Spectroscopy of Flames. By A. G. Gaydon (Chapman & Hall), 1957. Pp. x + + 279. Price 50 *sh.*

The great utility of the study of flame spectra lies in its ability to yield information about intermediate products in combustion processes. Since these intermediate products, called radicals, have a life-time of the order of 10^{-8} sec., their presence cannot be detected by any chemical means. Combustion plays a vital role in generation of energy in many important means of transport such as the internal combustion engines in motor cars, aeroplanes, etc. The advent of jet engines and rockets flying at speeds greater than that of sound (supersonic flow) give rise to phenomenon of shock waves, which are amenable to analysis by flame spectra. A book dealing with such wide applications of flame spectra is therefore greatly welcome.

In earlier years, the principal interest in the study of flame spectra lay in identifying the radicals giving rise to various spectra. Well-known among those were the water vapour bands (OH), hydrocarbon bands (CH) and carbon bands (C^2), which are also of great astrophysical importance. Now, however, successful efforts have been made to understand what part such radicals play in combustion processes. Since information about chemical reactions can be obtained by better control of the flame, or the nature of the reacting species, new experimental techniques have been developed, among which are flat flames, low pressure flames, low temperature flames, atomic flames, flash-photolysis, and shock tube excitations. These are described in Chapter III.

Three chapters cover discussions of the spectra of well-known flames, like hydrogen, carbon monoxide and hydrocarbon flames. The problems which arise in individual flames, such as the nature of the emitter of CO flame bands or the intensity distribution of OH bands are treated in detail. In a separate chapter (Chapter VIII) are described spectroscopic methods of measuring flame temperatures (vibrational, rotational and translational) which have yielded valuable data regarding the mechanism of production of different radicals.

Chapter X has been devoted to an interpretation of the spectroscopic data described in previous chapters. This deals with the nature of chemical reactions in cool flames, diffusion flames, premixed flames and the reactions forming excited radicals.

Flames produced in inaccessible regions such as the internal combustion engines and the jet engines have been studied spectroscopically, which has thrown considerable light on the phenomenon of "knock" and the nature of exhaust flames in jet engines. These are discussed in Chapter XI.

Other flames, whose spectra are described in the book (Chapter XII), are various organic flames, like NH_3, halogens, etc. Infra-red emission from flames is also included in a separate chapter (Chapter IX).

The book has several plates and an appendix giving data on the characteristics of band-spectra emitted by flames.

Spectroscopic studies of combustion is an important field of research, particularly with the advent of jet engines and rockets. A book devoted to such a subject is of considerable help to research workers in this field. The book will also be useful to those who wish to get acquainted with the contributions of spectroscopy to a better understanding of the phenomenon of combustion.

V. M. W.

Infra-red Absorption Spectra of Steroids—An Atlas, Vol. II. By G. Roberts, B. S. Gallaher and R. N. Jones. (Interscience Publishers, New York), 1958. Pp. 95. Price $ 20.

The highly characteristic infra-red absorption spectra exhibited by individual steroids have been often utilized for the identification of these compounds. As the amount of the compound involved is minute in quantity, this method of 'fingerprint' analysis is the simplest and at the same time most precise. The present volume contains, besides, an introductory chapter and table of characteristic group frequencies, 452 spectral charts of diverse compounds the region of absorption recorded ranging in general from 600 to 1,800 $cm.^{-1}$ and in some cases up to 4,000 $cm.^{-1}$ The present atlas will prove valuable to all laboratories engaged in the isolation, synthesis and identification of steroids and related natural products.

D. K.

Absorption Spectrophotometry. Second Edition. By G. F. Lothian. (Hilger & Watts, Ltd., London), 1958. Pp. viii + 246. Price 52 *s.*

Most of the chapters of this second edition on absorption spectrophotometry have been re-written to keep in step with the vast developments that have taken place in this subject since 1949, when the first edition was published. The book is divided into three parts dealing

with the principles, applications and techniques of spectrophotometry. In the first part are dealt, in detail, the effects of finite slit widths, measurements on diffusing specimens and the total intensity of a band. A few typical examples of the several growing applications of spectrophotometry are discussed in the second part. The third part is devoted to the modern instrumentation, which covers also the vacuum ultra-violet region. The design, operation and adjustment of the instruments and related topics like cells, solvents and standards also figure in this section. The book includes a list of publication on the subject for further reading and exhaustive references to recent original papers and commends inself as a valuable introductory text to students and workers in this field.

D. K.

Colorimetric Determination of Non-Metals. Edited by David F. Boltz. *Chemical Analysis*, Vol. VIII. (Interscience Publishers, Inc., New York), 1958. Pp. xii + 372. Price $ 8.50.

The literature covering the field of Colorimetry continues to grow. It is not always possible for any publication to keep pace with the published work on many divisions of Chemistry. In Colorimetry new methods, modified classical methods, improved techniques, and better instrumentation have resulted in many interesting developments.

This book is the eighth volume in the "Chemical Analysis" series of monographs published by the Interscience Publishers. This volume and the volume (Vol. 3) on "Colorimetric Determination of Traces of Metals" published by the same publishers together are intended to form a complete unit. The publication of a book of this type was overdue. Numerous methods have been perfected for the colorimetric determination of metals and a number of publications are available on this subject. However, reliable methods on the colorimetric determination of non-metals are meagre and they are mostly indirect.

The book is divided into eleven chapters and the first introductory chapter deals with the general principles and practices of colorimetric analysis under the heads of Visual and Photoelectric Colorimetry, Spectrophotometry, Turbidimetry and Nephelometry ; specific methods to be adopted keeping in view the solution variables in the preparative procedures and the general procedures to be adopted for the separation and isolation of the desired constituents from the interfering elements. The methods of separation and isolation of the concerned elements given in each chapter are clear and concise.

The second and subsequent chapters deal with the estimation of the various elements like phosphorus, silicon, nitrogen, chlorine, bromine iodine, fluorine, sulphur, tellurium, selenium and boron. Each chapter is divided into three sections and the first deals with the separation and isolation of the particular element ; the second deals with the methods adopted for the actual determination and the third with the specific applications of these methods.

The only leading method given for the determination of phosphorus (as orthophosphate) is as molybdenum blue (Heteropoly Blue) derived by the reduction of the phosphomolybdate or the phosphovanadomolybdate. The determination of silicon is also largely accomplished in a similar way by measuring the transmittance of the molybdenum blue or by measuring the transmittance and absorbance of the yellow molybdo-silicic acid complex. The determination of nitrogen is dealt with in great detail. The main principle is to convert the nitrogenous material into an ammonium salt, liberate ammonia and estimate it by the Nessler reaction. Nitrite is determined by diazotization and coupling reactions and nitrates by using either phenoldisulphonic acid or brucine as a reagent. Chlorine is determined using O-Tolidine while chloride is determined by using silver salts or mercuric nitrate. Chlorate and hypochlorite are determined by using benzidine and methylene blue for perchlorate. Bromine is determined either by König's reaction or by methyl orange, phenol red and rosaniline. Iodine is determined by its action as a catalyst and by the starch-iodine procedures. Fluorine is determined indirectly by displacement of a colour-forming ion from a complex like oxidised titanium solution, ferric thiocyanate, or a lake like that of alizarin and zirconium. Sulphur is converted into sulphates or sulphides and determined by turbidimetric methods or by reduction to hydrogen sulphide and determination by methylene blue. Selenium and tellurium are determined by reduction to the elemental form as coloured sols. Boron is estimated using quinalizarin or carminic acid or dianthramide in the presence of strong sulphuric acid or by curcumin in an alcoholic or aqueous medium.

At the end of every chapter a comprehensive and useful bibliography on the concerned subject is given and at the end of the book a

useful table of transmittance-absorbance conversion is given.

Considering the scope of the book it should be said that the chapter on phosphorus does not deal with the subject in full, particularly no procedure is given for the separation and estimation of phosphorus in soils and plants, in silicates, ores, etc. No reference is made about the determination of oxygen, ozone, carbon and its oxides and major organic compounds. The authors have no doubt taken great pains in selecting their material and making each article as concise as possible. But it would have been more helpful if sufficient data had been given on the subject of the actual preparation of the solution from the various materials that are to be tested.

The book is well written and presented and would be extremely useful to all students of analytical chemistry.

N. JAYARAMAN.

Surface Active Agents and Detergents. Vol. II. By Anthony M. Schwartz, James W. Perry and Julian Berch. (Interscience Publishers, Inc., New York), 1958. Pp. xv + 839. Price $ 17.50.

Literature on the chemistry and applications of surface-active substances is growing at such an enormous rate that great effort is needed to keep abreast with the up-to-date advances in any particular branch of this subject. The immensity of the task can be gauged by the fact that between 1948-56 there are nearly seven hundred publications dealing with the processes for synthesising and manufacturing surfactants. When authors undertake such a stupendous task, it is only natural that they cannot give a critical account of every aspect of the subject-matter dealt with. But this is more than compensated by the extensive and exhaustive survey of the literature.

The volume is divided into four parts: Part I dealing with the processes for synthesising and manufacturing surfactants and Part II with special function surfactants and compositions, in which the surfactants are functionally classified into ten sections like surfactants for non-aqueous systems, for germicidal and fungicidal applications, anticorrosive compositions, textile processing applications, etc. Grouping of this type will be of great advantage to industrial chemists who can have an outline of the applications of surfactants in their specialised branch of study. But the sections on analysis and analytical behaviours of surfactants, inorganic and organic builders and additives used with surfactants are out of place in this part. Part III is devoted to the Physical and Colloidal Chemistry of surfactants in theory and practice. In this part the Physical Chemistry principles of surface processes like adsorption and surface layer formation, bulk properties of surfactant solutions, foaming, wetting, emulsification and detergency are outlined. This part, although quite informative for a beginner, is a bit disappointing to a specialist in theory; perhaps the space allotted was inadequate for a detailed discussion of the theory. Part IV gives a fund of information regarding the practical applications of surfactants to a variety of industrial and miscellaneous purposes. The book is very well got up and the printing is excellent. Typographical errors are very few indeed and the authors are to be congratulated for bringing out this valuable book which is indispensable to any chemist interested in the theory and practice of the surfactants.

M. R. A.

Enzymes. By Malcon Dixon, F.R.S. and Edwin C. Webb, M.A., Ph.D. (Published by Longmans Green & Co.), 1958. Pp. xxxiii + 782. Price 90 *sh.* net.

The ever-increasing tempo in enzyme research certainly needs a standard text-book on the subject for purposes of ready and facile reference. Such a need is admirably filled by the book under review. It is an authoritative treatise on the general principles of enzymology rather than its methodology. It imparts rather than informs and is, therefore, thought-provoking. It is excellent for its matter, for its presentation and for its get-up. It is written in an expert way in classroom lecture style, masterly in arrangement and clarity. Many tables are presented, docketing useful information in a condensed form. This is a novel and welcome feature of purveying information and is worth emulating in general, in text-books. The title of the book is not sufficiently indicative of the depth, range and richness of information provided, nor of the method of treatment. No review can do adequate justice to its value. One may get perhaps some measure of it if it is pointed out that the authorship is steeped in the best traditions set by that great master, Hopkins, with whose many sage words, the book begins, resounds and ends, and, therefore, glows.

Basic knowledge about enzymes more than that contained in the introduction would be

necessary to follow the rest of the 12 chapters written in the esoteric language of enzymology under the captions, "Techniques", Isolation", "Kinetics", Reaction", Specificity, "Mechanisms", "Inhibitors", "Cofactors", "Structure", "Formation", Systems" and "Biology". This arrangement follows in a sense the stages in the development of our knowledge on this dynamic subject.

As occasionally happens even in the best prepared lecture, there are minor defects of omission and commission. For example, every one will not agree with the authors that the device sometimes adopted by them of referring to the enzymes by their numbers (given to them in Table V, 1) is the most convenient. Some of the foot-notes (*cf.* pp. 395, 568) are unduly long and act as a lump in reading the text. Though a bibliography arranged in alphabetical order according to the first author is provided, still an author index was necessary in fairness to all the collaborating authors in a conjoint effort. The rare collection of microphotographs of crystalline enzymes given in the opening pages could have been presented in an alphabetical order. In the chapter on "Enzyme Techniques", a sub-title "Classes of Methods" does not appear to be quite exact. Dilatometric methods once used in kinetic studies do not find a mention. In describing tests for dehydrogenase activity (pp. 30-31) omission to refer to methods based on the use of the tetrazolium salt as an electron acceptor is a little puzzling. "Enzyme Kinetics" has deservingly met with the most detailed treatment. Chapter V is unique because of the novelty in presentation. It contains an exhaustive table listing 659 enzymes, grouped functionwise, giving against each enzyme information concerning active groups and cofactors, source, substrate or reaction with references. Preceding text is a description of the table, while the succeeding one is devoted to a more detailed discussion. Available information on the specificity of enzymes has been marshalled in Table VI, 1. As against this, Table VI, 5 relating to the specificity of glucose oxidase is an offender and looks odd, containing, as it does, almost a whole column of zeros (because with each of the 39 substrates cited, the rate of oxidation is zero). Co-enzyme I and Co-enzyme II get special treatment and steps involved in arriving at their configuration are described in detail. It is difficult to justify the major treatment given in insulin in several contexts in the book. In dealing with the reducing properties of ascorbate (p. 409), it would have been more realistic to have referred to reducing capacity of ascorbic acid towards *acid* silver nitrate. In showing the difference in the configuration of folic acid and its anti-vitamin aminopterine (p. 446), the differing groups could have been distinguished in bold print. As regards the influence of metal ions, the following statement (p 448) "Some ions are poisons for some enzyme and activators for others: some may even inhibit an enzyme at one concentration and be an activator of the same enzyme at another" needs support from examples and literature references. The chapter on "Enzyme Structure" is incommensurate with the promised fare. Real knowledge giving some insight into enzyme formation is comparatively a recent acquisition, having had to depend on the development of tracer technique for providing evidence. These results only bear out, as the authors point out, the obvious conclusion that the biosynthesis of an enzyme is ultimately the biosynthesis of a protein, the explanation for modification into an active species being sought in genic control. In the last chapter under the heading "Enzyme Biology", such speculative subjects as enzymes in relation to life and their origin are discussed freely. Perhaps the authors could have risked a little more and taken a peep into less chartered areas and given us a travelogue of the looming pastures like aromatisation and unfathomed seas like the phenomenon of optical activity.

This authoritative and comprehensive book will be widely welcomed by students and research workers in the field and is sure to remain a standard reference on enzymes till it is replaced by the next edition by the authors themselves.

M. SRINIVASAN.

Methyl Glucoside. By C. N. Bollenback. (Academic Press, Inc., Publishers, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. 189. Price $ 5·50.

The book under review deals with the occurrence, preparation, physical constants and derivatives of methyl-D-glucopyranosides and methyl-D-glucofuranosides. It contains well over 500 references collected up to 1956, as well as unpublished information from the records of Corn Products Refining Company with which firm the author is connected. The section on the derivatives is the largest and is valuable to those interested in the various uses of these substances. Certain derivatives such as the anhydro and deoxy compounds have not been

included in this book, as useful reference library on these is available.

The general arrangement and get-up of the book are indeed excellent. The book is, however, of interest only to the specialist working in the field and will be a useful addition to any reference library.

N. V. SUBBA RAO.

New Frontiers of Knowledge. (Public Affairs Press, Washington, D.C.). Pp. x + 125. Price $ 2·75.

This book is based upon the series of talks broadcast by the U.S. Information Agency during the year 1957. Although known in parts to many through the press and the radio, this publication in a collected form will be welcomed by the general reading and thinking public.

"The frontiers of knowledge and humanity's hopes for the future" was, in essence, the main theme on which distinguished men of the world were invited to participate. Here we have 36 men belonging to 14 different countries drawn from such varied fields as philosophy, mathematics, religion, law, government, history, economics, education, literature, anthropology, biology, psychiatry, medicine, physics, technology, planning and co-operation, giving their considered opinions, based on experience and deep thought, on the new problems facing mankind in this nuclear era.

Evidently the staggering advances in science and technology and the growing expansion in the frontiers of knowledge are creating new problems. From one point of view the effect of the increased speed of scientific and technological processes is, as John Von Neumann says, "that it has not only enlarged the size of political, economic and cultural units, but it has also at the same time increased the danger of collision among nations, among economies, among cultures."

From another point of view, these rapid advances in science have created an awareness in the minds of men and the achievements of science are looked upon not with admiration but with philosophical thinking on the Universe, the creation and the purpose of living. As Bridgmann says "the most important impact of science is not in its transformation of the external conditions of our daily living, but in something deeper, namely, in our complete world outlook". According to Arnold Toynbee "the rise of modern science has created a spiritual vacuum in man", and as science has expelled religion, he pleads for the "recovery of religion".

The ordinary man, standing in the middle of the century on the threshold of a new age and looking around to the rapidly expanding frontiers of knowledge, can only watch, and perhaps think, but he cannot come to any conclusion. It is here that this little volume containing the thoughtful convictions of learned men of the world from different spheres of activity comes to his aid and gives him hope to face the future with confidence that the tremendous force that has been discovered will be directed not toward death but toward life.

A. S. G.

Organic Syntheses with Isotopes—Part I. Compounds of Isotopic Carbon. By Arthur Murray and D. Lloyd Williams. (Interscience Publishers, New York, London). 1958. Pp. 1146. Price $ 25.00.

The need for a compilation such as the volume under review has been increasingly felt with the growing popularity of tracer methodology. Details of synthetic procedure with isotopes are scattered throughout the scientific literature extending from Agriculture to Zoology and covering many different languages. It is not easy for a prospective user of an isotopically labelled compound to find out whether the compound under question has already been synthesized or not, unless he has ready access to a vast reference library. Moreover, in the current scientific literature the practice of giving experimental details of new isotopic syntheses does not appear to be popular. In most cases a new synthetic procedure is presented in the barest outline.

Syntheses of labelled compounds involve the best techniques and skill the organic chemist can put forward and something more. The high price of isotopes and very often the hazards associated with the use of them require that the synthetic procedure be carried out with a degree of precision which is not necessary in routine non-isotopic organic synthesis. Usually the synthesis of a labelled compound which appears as a condensed short paragraph in scientific literature represents months and sometimes years of hard work comprising of standardization of the best conditions for the synthesis in non-isotopic pilot runs, the reproduction of the highest yields with trace amounts of isotopes, the proof by unambiguous methods of the purity of the desired product and of the desired location of the isotope in the molecule and finally the full-scale isotopic synthesis. Furthermore the ingenuity of the investigator is very often

put to the test to obtain the maximum isotopic recovery in the desired product.

The authors, therefore, are fully justified in suggesting in the preface that the book should not be confined in its uses to the labelled compounds alone but it should be of considerable interest to the organic chemist, as the procedures were chosen for or developed to give high yields. Among many interesting examples, the dihydroresorcinol procedure for synthesis of long chain fatty acids and the elegant syntheses of many aminoacids involving the substituted hydantoins may be of interest to the organic chemist.

It is noteworthy that already some confusion has developed in literature regarding the nomenclature of isotopically labelled compounds and the precise formulation of six basic rules of nomenclature in the introductory chapter is timely and useful. The introduction also deals with some essential information about the properties and procurement of isotopes and a brief outline of tracer methodology. Cross-references are given to the standard literature on these subjects to assist the new-comers in this field.

The different classes of labelled compounds have been arranged alphabetically beginning with the acids and concluding with the vitamins. The syntheses of a few key intermediates, such as acetate, formate, cyanide, etc., are dealt with in exhaustive detail including alternative methods. New equipments used have been described and illustrated in many cases. Dr. Murray has the distinction of being one of the pioneers in radiocarbon syntheses and the subtle tips regarding the procedure from the accumulated experienced of the authors and other workers in this field described in the notes following the experimental procedure would be of great assistence to the users of this book. The description of each synthesis follows closely the standard sequence adopted in Organic Synthesis—the experimental procedure, notes and suggestions, alternative methods and a wealth of references.

It would have been better to include an index at the end of each volume instead of a cumulative index with Part II which deals with the synthesis of organic compounds labelled with isotopes other than carbon. Such a procedure would have saved the user the inconvenience of handling two bulky volumes instead of one. The reviewer hopes that this small oversight will be rectified in the subsequent editions.

The book should be unreservedly recommended for every organic chemistry library.

P. K. B.

The Nucleus. (*An International Journal of Cytology and Allied Topics.*) Published in two issues a year. [Editorial Office, Kalputuru Palace, 223, Chittaranjan Avenue (North), Calcutta-6.] Price Rs. 13-00 per issue.

It is a pleasure to welcome the first issue of *The Nucleus* edited by Dr. A. K. Sharma with the aid of Advisory Board composed of leading cytologists like Prof. Kihara of Japan, Prof. Riley, Prof. Taylor and Dr. Kaufmann of U.S.A., Prof. Oehlkers of Germany, Prof. Love of Canada and Prof. Sirks of Netherlands.

The get-up is attractive and the reproduction of photographs good. If the standard of contributions in this issue is any indication the journal has a promising future.

M. K. SUBRAMANIAM.

Books Received

Potato in West Bengal. By H. C. Choudhuri. (Department of Agriculture, Govt. of West Bengal, Writers' Buildings, Calcutta), 1958. Pp. 125. Price Rs. 6.

Industrial Hygiene and Toxicology—General Principles, Vol. 1. Second Revised Edition. Edited by F. A. Patty. (Interscience Publishers, New York), 1958. Pp. xxviii + 830. Price $ 17.50.

Mycology and Plant Pathology. By S. N. Das Gupta. (Indian Botanical Society, University Botany Laboratory, Madras-5), 1958. Pp. iv + 118. Price Rs. 5.

Animal Disease and Human Health. By J. Lieberman. (*Annals of the New York Academy of Sciences,* New York), 1958. Vol. 70, Art 3. Pp. 277-762.

Nuclear Scattering. By K. B. Mather and P. Swan. (Cambridge University Press, London N.W. 1), 1958. Pp. viii + 469. Price 80 *sh.*

Grundriss Der Photographie Und Ihrer Anwendungen Besonders in Der Atomphysik. By G. Joos and E. Schopper. (Akademische, Verlagsgesellschaft, m.b.h. Frankfurt am Main), 1958. Pp. xii + 408. Price not given.

Palœmon. By S. S. Patwardhan. (The Zoological Society, Calcutta-12), 1958. Pp. xiv + 102. Price Rs. 5.

Solid State Physics—Nuclear Quadruple Resonance Spectroscopy. By T. P. Das, E. L. Hahn. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. ix + 223. Price $ 7.00.

SCIENCE NOTES AND NEWS

Veb Carl Zeiss Jena at the Indian Science Congress Exhibition, New Delhi, Jan. 1959

Messrs. Gordhandas Desai (Private) Ltd., Bombay-1, write that their Principals *Veb Carl Zeiss Jena* will be participating in the above Exhibition with a very representative display of their production programme. Their latest instruments will be exhibited at Stall No. 11.

Of special significance on this occasion will be the presence of six experts from the Zeiss Works who will personally attend the Exhibition. After the Exhibition these experts will undertake a tour for a duration of one month of the country to personally attend to matters such as the choice of equipment for special work and intended projects in research.

Lady Tata Scientific Research Scholarships, 1959-60

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1959-60 commencing from 1st July 1959. Applicants must be of Indian nationality and *Graduates in Medicine or Science* of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1959. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, "Bombay House", Bruce Street, Fort, Bombay-1.

Racine Prize for Mathematics

A cash prize of the value of rupees one thousand, will be awarded to the best research paper in mathematics published before 31st December 1961 by an Indian Mathematician who is under 30 years on that date. Unpublished manuscripts or papers in the course of publication on that date will also be accepted for consideration for the award, if four typewritten copies of the same are sent, before the said date, to the address given below. An international panel of judges will be constituted to adjudicate on the award.

All communications should be addressed to Dr. K. G. Ramanathan (Convener, Racine Prize Committee), Tata Institute of Fundamental Research, Apollo Pier Road, Bombay 1.

Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri Shashikant Avantilal Vasavada for his thesis "Studies in the Autoxidation of Fats".

2nd International Congress of Polarography

The above Congress organised by the Polarographic Society will be held in Cambridge from 24th to 29th August 1959. Prof. Heyrovsky, Head of the Polarographic Research Institute of the Czechoslovakian Academy of Sciences has agreed to give the opening address. The proceedings will be published in book form and will be dedicated to Prof. Heyrovsky's 70th birthday.

The scientific programme will be divided into the following Sections: 1. Instrumentation, 2. Theory and Kinetics, 3. Analytical and Industrial Applications, 4. Fundamental Studies, 5. Biological and Medical Applications, and 6. Miscellaneous.

Contributions will be welcome and should be submitted to: G. F. Reynolds, M.Sc., F.R.I.C., C 36 Royal Arsenal, Woolwich, London S.E. 18. Abstracts not exceeding 200 words should be received by 31st March 1959, and final manuscripts by 31st May 1959.

For further details write to: Mrs. B. Lamb, B.Sc., F.R.I.C., Chemistry Laboratory, Eversheds and Vignoles, Corner of Eveagh Avenue, North Circular Road, London N.W. 10, England.

The Institute of Physics

A one-day symposium entitled "Current developments in the production of high vacua" will be arranged in London on 17th April 1959.

There will be three sessions: (*a*) Chemisorption and ionic pumping in kinetic vacuum systems; (*b*) Problems in the production of high vacua in large equipment; (*c*) Analysis of residual gases in kinetic vacuum systems.

A Conference on "Some aspects of magnetism" will be arranged in Sheffield from 22-24 September 1959.

The subjects to be covered by the conference are: (*a*) Fundamental theories of ferro-, ferri- and antiferromagnetism, including magnetic structure, (*b*) Theories of technical magnetization processes, including hysteresis, coercivity, anisotropy and directional effects, (*c*) Theoretical and experimental studies of domain phenomena in bulk materials and thin films, (*d*) Experimental and theoretical studies of antiferromagnetism in metals and non-metals.

These are intended mainly for persons working in the field. All communications regarding the symposium should be sent to the Secretary, The Institute of Physics, 47 Belgrave Square, London S.W. 1.

Industrie Chimique Belge—Special Issue

The XXXI International Congress of Industrial Chemistry organized in Liege by the Federation of Chemical Industries of Belgium, was held during the Brussels World Exhibition. About 350 lectures and papers of a high scientific value have been presented on this occasion, on subjects covering almost the entire field of the chemical and para-chemical industries. The periodical "Industrie Chimique Belge—Belgische Chemische Industrie" will bring out before long a special issue, in which the full texts of all lectures and papers together with the interventions and discussions will be published.

This special issue will undoubtedly be of considerable interest for all those concerned with the development of the applied chemistry. Subscriptions to this Congress Report, the price of which has been fixed at 1800 B.F. should be sent to the General Secretariat, 32, rue Joseph II, Brussels, Belgium.

Magnetic Recording by Electrons

A way of using a magnetic film and an electron beam to produce stable but erasable records of information is being developed by Ludwig Mayer of Minneapolis. He calls his technique "Curie-point writing". The Curie point of a magnetic material is the temperature at which its magnetism is destroyed. The manganese-bismuth discs which Mayer is using have a Curie point of 350° C.

He preheats the discs to 300 degrees, fully magnetised in one direction. He then writes on them with an electron beam, which is made to move by ordinary TV methods. The effect of the beam is to heat the film where it strikes above the Curie point. Thus the magnetism along the trace of the beam is destroyed, and when these regions cool down again below the Curie point they become remagnetised under the influence of the rest of the film; consequently they are magnetised in the opposite direction to the rest of the film.

The writing can be read using light or electrons. It can be made to appear black on a light background if the film is observed under polarised light. Alternatively (by the technique of the electron mirror microscope) electrons reflected from the film are so affected by the magnetic field at the boundary between the writing and the rest of the film that, in the micrographs, the writing appears like raised humps on the film.

The first experiments established that 100,000 bits of information could be stored on one square centimetre of film, and written on in about 3 seconds. Mayer is confident that the writing speed can easily be increased tenfold, and that half-tone magnetic images could be produced by varying the sizes of the "black" dots. Any impression can be instantly erased by a magnet, provided the heating used in the writing is not excessive.—*Journal of Applied Physics*, Vol. 29, p. 1454.

Ceramic Electret Microphone

Organic electrets of resins, wax and rubber have been known for many years. Ceramic electrets belong to a new class of dielectrics which have been developed at the Physics Institute of the USSR Academy of Sciences. A plate of this substance when heated to 200° C., and gradually cooled in a strong electric field acquires the property of storing up opposite charges of electricity on its two sides and retaining them for many years. Electric energy is frozen at it were in the processed plate and can later be utilized in various instruments.

A ceramic electret microphone consists of a disc of this processed plate with the vibrating membrane superimposed on it. Telephones with these microphones, it is reported, have been working in the Institute for over a year without any outside source of power. Only the ceramic plates need be changed to ensure continued functioning. A ceramic electret microphone is superior to other types in clearness of sound and effective range. It is not affected by outside mechanical or temperature influences.

Ceramic microphone is only one of the ways of using this new class of dielectrics. Inorganic electrets are opening up broad prospects for the

development of new radio equipment and high precision measuring instruments. They have been used in radicactivity dosimeters of great precision. An electret voltmeter is found to be ten times more sensitive than a conventional one.—*USSR News Bulletin.*

Superfluid State of Nuclear Matter

The hypothesis of the superfluid state of nuclear matter was first advanced by Nikolai Bogoliubov of the USSR Academy of Sciences in his report to the Second Atoms for Peace Conference in Geneva. According to this hypothesis elementary particles in an atomic nucleus are paired as are electrons in a superconducting metal and atoms in liquid helium. This hypothesis was confirmed by Prof. Migdal's experiments. Speaking before Moscow scientists at the Physical Problems Institute headed by Academician Pyotr Kapitza, Prof. Migdal stated that by means of Bogoliubov's theory and mathematical method he was able to carry out one of the most precise experiments in the sphere of the structure of nuclear matter. His measurements of the torque of atomic nuclei revealed that it was not the entire mass of the nucleus that was rotating but only a small part of it—its envelope. This phenomenon, in his opinion, constitutes direct proof of the superfluidity of atomic nuclei.

Prof. Migdal considers that the discovery of the new phenomenon will not only make it possible to study transformations occurring in the atomic nucleus but also shed light on the nature of certain stars. He replied in the affirmative to the question about the possible existence of superfluid stars the bulk of which is composed of nuclei of neutrons alone.

He stated that the pair bonds formed in a nucleus by protons and neutrons are evidently not the only force operating in the atomic nucleus. Academician Pyotr Kapitza pointed out that the pair bond between nuclear particles removed from each other was a new fundamental phenomenon which until now escaped physicists' attention.—*Soviet News.*

Tracer Technique to Study Gibberellic Acid Mechanism

Gibberellic acid is one of the few natural growth regulators that has been discovered in plants. Gibberellin compounds were first discovered in a species of fungus in Japan. Gibberellic acid, which is now commercially available, is in the form of a fine white powder which is usually dissolved in solution and applied to plants in spray or droplets. It can make the stems grow longer, increase the length of the leaves, improv the fruit yield, and act as a substitute for ligh or temperature in some germination and flowe ing processes. Because it can produce such variety of responses, scientists think it will he them to obtain a better understanding of t hormonal mechanisms that control growth pa terns in higher plants.

Plant Physiologists at Argonne are using t radioactive tracer technique to find out ho plants utilise the acid. In this method "tagge atoms of gibberellic acid which emit flashes radioactivity detectable by monitoring instr ments are traced wherever they go in the pla system. To make a radioactive form of t acid, Argonne scientists introduced sucro labelled with carbon-14 into the fungus which it is found. The hormone was the isolated by chemical means. Work at Argonn has already demonstrated that hemp, tobacc lupine, sunflowers and bean plants are respo sive to acid. In west coast areas of the U.S.A grapevines treated with gibberellic acid hav produced a greater yield of fruit per cluster.

Using hemp plants, Argonne scientists note a new growth-regulating effect of gibberell acid. In hemp, female and male flowers a developed on separate plants. But female plant treated with hormone also formed function male flowers, thus altering the normal patter of flower expression. The quantity of ac needed to induce changes in plants may be a little as a thousand-millionth of a gram. I the Argonne experiments, the acid is appli to plant in drops, with device that resembles minute eyedropper. The researchers hav already found that plants tested by the labora tory distribute the acid most uniformly if is applied to the stem.

The work is still in its early stages, an much remains to be known about what plant do with the substance. However, in addition t furthering basic knowledge of plant mechanism research with the hormone will open the doo to a number of future applications involvin chemical control of plant growth and behavi our.—*Atoms for Peace Digest,* November 195

How Life Began

Hydrocarbons and their simple derivative began to appear in the earliest period of th Earth's history, but they were merely initia compounds, the first link in a long chain o transformations on the surface of a still lifeles Earth. In his report, Academician Oparin, wh is regarded as the World's leading authorit

on the origin of life, stressed that mechanical materialism had proved incapable of giving a well-founded answer to the question of how life began. He said that only dialectical materialism, which considered matter in constant motion and development from the simplest forms to more complex ones, had opened up the way to a solution of the problem.

Oparin believes that the entire history of the development of matter towards the appearance of life can be divided into three stages: the primary appearance of hydrocarbons and their derivatives, the appearance of numerous high molecular organic compounds and, finally, the appearance of albumen systems capable of metabolism. He told the conference that the possibility in principle of the second stage in the development of matter—from the simplest hydrocarbons to extremely complex organic substances—resided in the primary hydrocarbons themselves.

Under the action of radiant energy, and in particular ultra-violet light, electrical discharges and ionising radiation, hydrocarbons turned into complex organic systems. However, organic systems did not possess the specific properties of life when they first appeared. It was only later that they developed into primary living organisms. The data available, Alexander Oparin continued, "indicate that primary organic polymers were educed from a homogenous solution at a certain time in the form of multimolecular drops similar to the coacervate drops we have obtained in laboratory conditions. Each of them had its own particular structure.

Oparin pointed to three stages in the evolution of coacervate systems into living organisms; the development of an ability of self-preservation in conditions of constant interaction with the environment; the emergence of systems capable not only of self-preservation but also of growth, and the emergence of systems reproducing themselves in recurring reactions of the same type. "From that moment on," Oparin said, "life can be said to have appeared."—*Soviet News*, 11th November 1958.

Microhydropower Station

Semyonov, engineer of the Tyup Repair and Service Station (RSS), has invented an easily transportable small hydropower station which can be installed in streams running down mountain slopes for the production of electric power.

The microhydropower station consists of a 4-5 kw. generator and a turbine. In order that the microhydropower station could operate, a stream of 100 litres of water per second falling from a height of three metres is necessary. The generator and turbine are mounted on a special iron frame. It can be disassembled and transported on animals to the remotest parts of mountain pastures. In order that the station could operate smoothly the only thing required is the regular lubrication of the turbine's shaft bearings and the countershaft after which no further servicing is needed for a long time.

In the 10 kw. microhydropower stations which are being manufactured in the RSS workshop, there is a closed type jet turbine, the water will first come into the vortex chamber and will then press on the blades of the turbine shaft.

These are being largely used in collective farms situated far out in the mountains.—*Soviet Science Bulletin.*

Electric Station without Generators

An unusual boiler is on view in the Inventors and Rationalizers of Agriculture Pavilion of the USSR Agricultural Exhibition in Moscow. It produces steam, hot air and even electric current without a generator.

The sources of electricity are semiconductor thermoelectric batteries built into the boiler. They resemble matchboxes in form and are made of a special alloy which is capable of transforming heat directly into electricity. The batteries are heated in an unusual way—one side of them is constantly in contact with the boiling water at 100° C., and the other with the gases from the burning fuel at 700° C. This difference in temperature is sufficient for the batteries to produce enough electricity to use for lighting homes, for motors, a radio station, the work of a forage-preparing shop and other purposes.

The installation will be in wide use in farms located at great distances from big communities and sources of power.—*Soviet Science Bulletin.*

Russian Cosmic Rocket

What was indeed a spectacular step forward in space research and an outstanding achievement in accuracy was accomplished when Russia launched a cosmic rocket on January 2, 1959. The rocket had exceeded the second cosmic speed necessary for interplanetary flights. On January 4, the rocket reached its nearest point of approach to the moon, 3500 miles, passed by it and set out on its onward journey to its planetary path around the sun. On January 7, the rocket started on its orbit round the sun as the first man-made planet. It is expected that the artificial planet will pass within observable distance of the earth once in five years.

The last stage of the rocket weighing 1472 kg. without fuel, was equipped with a special container inside which were placed the measuring instruments for carrying out the following scientific observations : Magnetic field and radioactivity of the moon; Intensities and intensity variations of cosmic rays outside the earth's magnetic field; photons and heavy nuclei in cosmic radiation; gas components in interplanetary matter; corpuscular solar radiation; study of meteoric particles. Data about Moon's magnetic field, if it has one, will throw light on the current hypothesis that the magnetic fields of celestial bodies depend on their rotation.

For observation of the flight of the last stage of the rocket there have been installed in it a radiotransmitter operating on two frequencies—19·997 Mc and 19·995 Mc-emitting beats lasting 0·8 and 1·6 seconds; a radio transmitter on 19·993 Mc, emitting beats of variable duration of ·5 to ·9 seconds used to transmit scientific observations data.

The total weight of scientific and measuring instruments together with sources of current supply and container is 361·3 kg. Data sent back to earth had all been received and are now being deciphered. When completed, which will take some time, the results would be made available to the whole world.

The rocket carried a special device to create a sodium cloud of an artificial comet. "The sodium cloud" the original announcement said, "will be formed on January 3, at about 0357 (Moscow time) and it will be visible for about two to five minutes in constellation of Virgo, approximately in the centre of a triangle formed by the stars Alpha Bootes, Alpha Virgo, and Alpha Libra". The cloud has been observed and photographed.

When on October 4, 1957, the world's first artificial earth satellite was successfully launched the *first cosmic speed* of 8 kilometres (about 5 miles) per second was obtained for the first time.

The present cosmic rocket had exceeded the *second cosmic speed* of 11·2 kilometres (about 7 miles) a second to become an artificial planet of the sun, having completely escaped the earth's attraction.

According to Professor Boris Kukarkin, Vice-Chairman of the Astronomical Council of the Soviet Academy of Sciences, it does not now appear to be a difficult task to send a rocket outside the solar system. If advantage were taken of the earth's "fling"—its own velocity—and if a rocket were launched in a certain direction the *third cosmic speed* would be attained.

Does the Sun's Atmosphere Extend out to the Earth ?

In a discussion on Space Research held by the Royal Society, Prof. D. R. Bates pointed out the remarkable implications which new data on air density, obtained from satellite observations, have concerning the heat flow conditions in the outer atmosphere. It appears that a source of heat from outside the Earth, considerably stronger than supposed hitherto, must exist. There is a possibility that this is connected in some way with Prof. Sydney Chapman's suggestion that the Earth must be regarded as a cold spot within the hot outer extension of the Sun's atmosphere. It has been known for some time that the bright disc of the Sun which we normally see is surrounded by a tenuous atmosphere, known as the solar corona, which extends out to distances several times the diameter of the visible disc. This corona is visible at eclipses and can be photographed by special techniques at other times. It is known also that the temperature of the corona is as high as 1,000,000° C. For certain theoretical reasons Chapman believes that it extends out much further than previously thought, cooling gradually as it recedes from the Sun so that near the Earth its temperature has fallen to 200,000° C. Even though the coronal density near the Earth would be quite small, amounting to only a few thousand particles per cubic centimetre, it might, because of its high temperature, provide sufficient heat to resolve the difficulties pointed out by Bates.

An important task for interplanetary probes will clearly be to determine whether the Sun's atmosphere does extend out to the Earth. This involves measurement of the concentration of particles in space and of their nature. Almost all of these particles will be charged, consisting of protons and electrons. In addition the temperature, or what is equivalent, the average energy of these particles would need to be determined.—*The New Scientist*, November 20, 1958.

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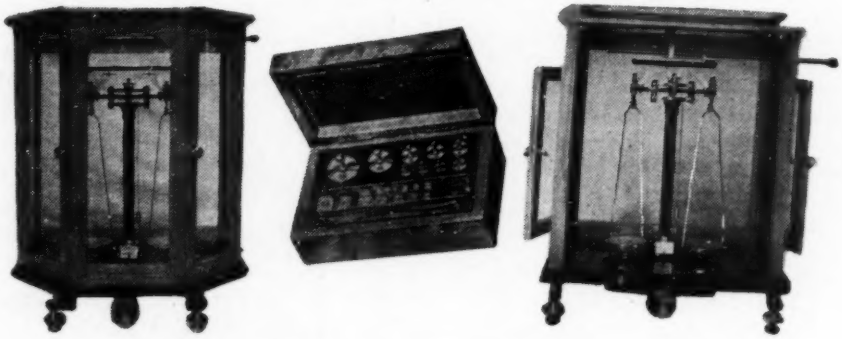

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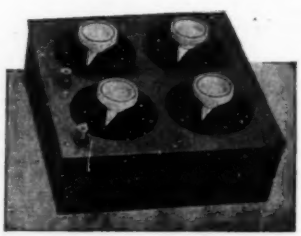

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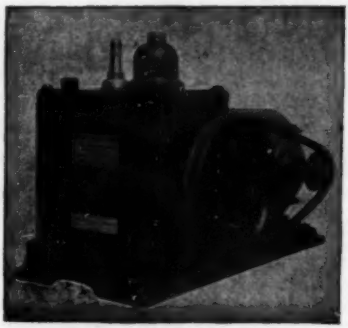

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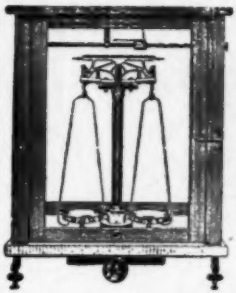

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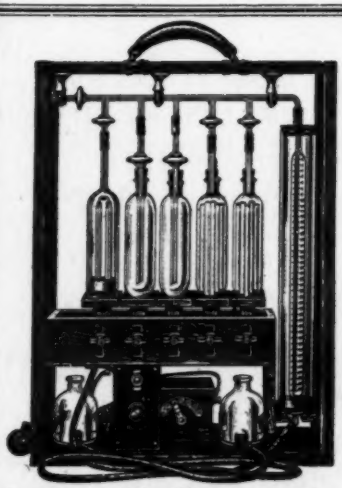

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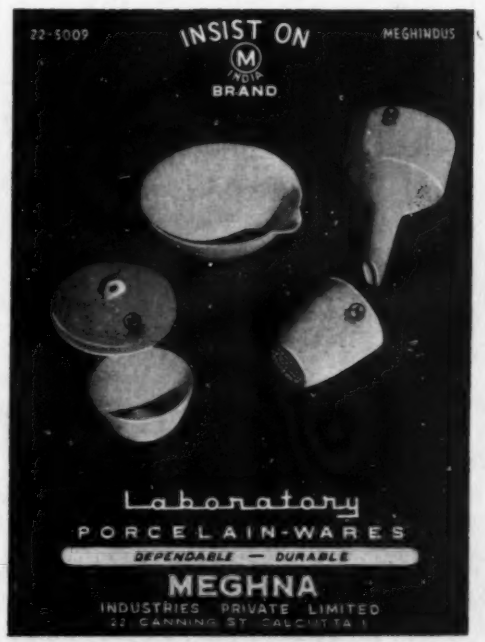

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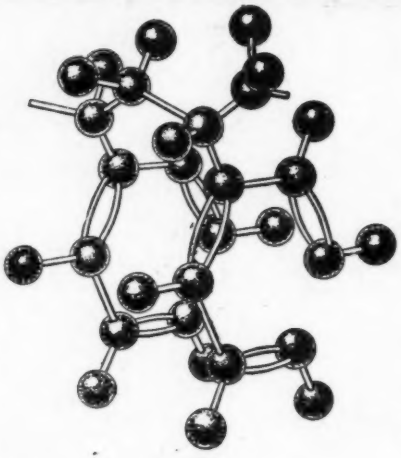

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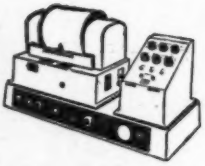

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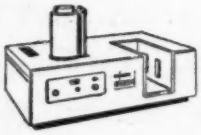

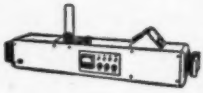

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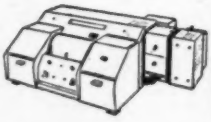

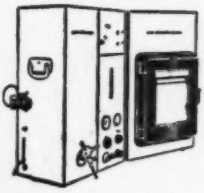

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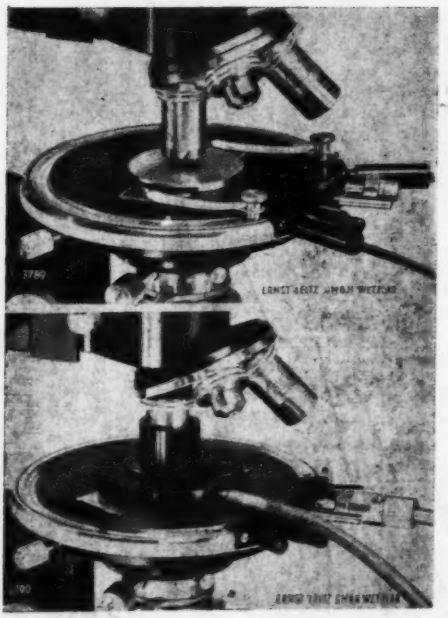

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